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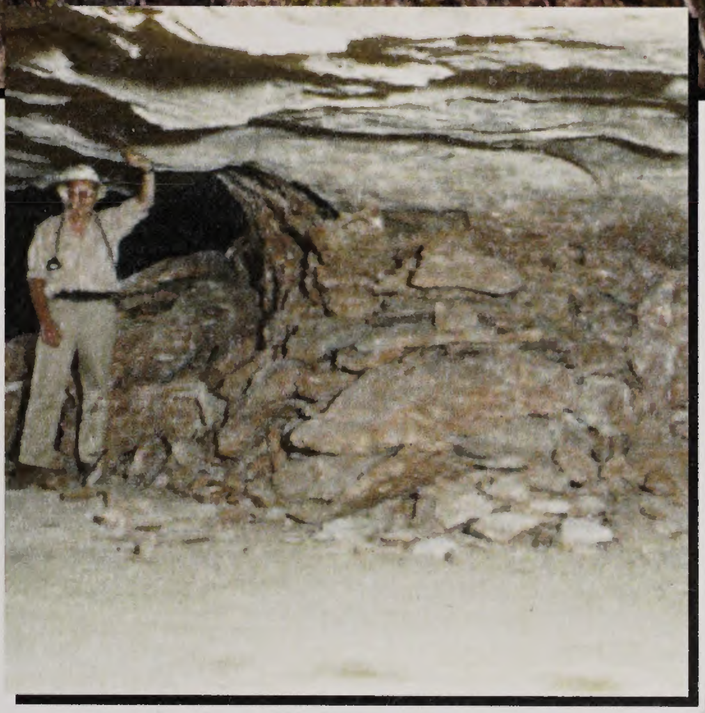
HB In-Situ Solution Mine Project
Final Environmental Impact Statement



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Carlsbad Field Office, New Mexico

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BLM Mission Statement

The Bureau of Land Management is responsible for stewardship of our public lands. The BLM is committed to manage, protect and improve these lands in a manner to serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife habitat, wilderness, air and scenic quality, as well as scientific and cultural values.

Cover photo captions:

- Top photo: View from Tower Hill looking north to the location of proposed evaporation ponds.
- Lower left: Harvesting potash precipitated from evaporation ponds. *Courtesy of Intrepid Potash.*
- Lower right: Ore pillar crushing out after second mining completed. Ore in the crushed out pillar is the primary ore target for the solution mine. *Courtesy of Intrepid Potash.*

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Final
Environmental Impact Statement
HB In-Situ Solution Mine Project
DOI-BLM-NM-P020-2011-498-EIS

Lead Agency:	U.S. Department of the Interior Bureau of Land Management Carlsbad Field Office
Cooperating Agencies:	City of Carlsbad, New Mexico City of Eunice, New Mexico City of Hobbs, New Mexico Chaves County, New Mexico Lea County, New Mexico New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division New Mexico Environment Department U.S. Department of Energy
Project Location:	Eddy County, New Mexico
Correspondence on this EIS Should be Directed to:	HB In-Situ Solution Mine EIS Project Lead BLM Carlsbad Field Office 620 East Greene Street Carlsbad, NM 88220 (575) 234-5972 Email: nmcfo_comments@blm.gov

ABSTRACT

Intrepid Potash, Inc. (Intrepid) is proposing to extract the potash remaining in inactive underground mine workings by constructing and operating an in-situ solution mine project, located approximately 20 miles northeast of Carlsbad in Eddy County, New Mexico. Instead of excavating the remaining potash in the remaining underground pillars and walls of the inactive workings, the process would inject saline water into the inactive mine workings and extract a mineral-rich solution. This mineral-rich solution would be pumped to the surface and transported to evaporation ponds. Once the solution evaporates in the ponds, the potassium-bearing salts would be harvested from the ponds and transported to a newly constructed mill for ore refinement.

The BLM's Preferred Alternative would require approximately 1,331 acres of new surface disturbance, the installation surface and buried pipelines within 82 miles of new rights-of-way, construction and operation of 4 groundwater pumping wells and 14 monitoring wells, construction of an evaporation pond system and a new processing mill, and pumping of a maximum of 2,267 gallons per minute of groundwater from combined sources. The proposed project would operate for 28 years.

This Final Environmental Impact Statement analyzes the environmental effects of the Proposed Action, the Preferred Alternative, two action alternatives, and the No Action Alternative.

Responsible Official for the EIS:	Jim Stovall, Field Manager Carlsbad Field Office

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Executive Summary

This Executive Summary is intended to provide a brief overview of the proposed project, alternatives, and conclusions from the impact analyses. For the supporting documentation and detailed analyses, please see the full environmental impact statement (EIS).

Project Overview

Intrepid Potash, Inc. (Intrepid) is proposing to extract the potash, a potassium compound commonly used for fertilizer, remaining in inactive underground mine workings. Intrepid proposes to construct and operate a solution mine project in an existing deep mine, located approximately 20 miles northeast of Carlsbad in Eddy County, New Mexico (see **Figure ES-1**).

Instead of excavating the remaining potash left in the remaining underground pillars and walls of the inactive workings, the process would inject saline water into the mine workings and extract a mineral-rich solution. This mineral-rich solution would be pumped to the surface and transported to evaporation ponds. Once the solution evaporates in the ponds, the potassium-bearing salts would be harvested from the ponds and transported to a newly constructed mill for ore refinement.

The project area, which encompasses the proposed facilities and inactive workings under consideration, includes a total of 38,453 acres, of which 31,439 acres (82 percent) is on public lands managed by the U.S. Department of the Interior, Bureau of Land Management (BLM), 4,954 acres (13 percent) is managed by the State of New Mexico, and 2,060 acres (5 percent) are privately owned. The project area is located within the Secretary's Potash Area (SPA), designated to provide guidance for the management of federal oil, gas, and potash leasing and development.

Purpose and Need for Project

Under the National Environmental Policy Act (NEPA) of 1969, there is a requirement to present the purpose and need for a proposed project. The "Regulations for Implementing NEPA" from the Council on Environmental Quality, 40 Code of Federal Regulations (CFR) §1502.13, state the following about the description of the purpose and need in an EIS.

> *"The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action."*

The purpose and need statement is intended to explain the reason that the proposed project is needed by the lead agency (BLM in this case) and serves as the basis for developing a reasonable range of alternatives.

The BLM is responsible for the balanced management of the public lands and resources and their various values in a fashion that will best serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield; combinations of uses that take into account the long-term needs of future generations for renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife, wilderness and natural, scenic, scientific, and cultural values (BLM 1997).

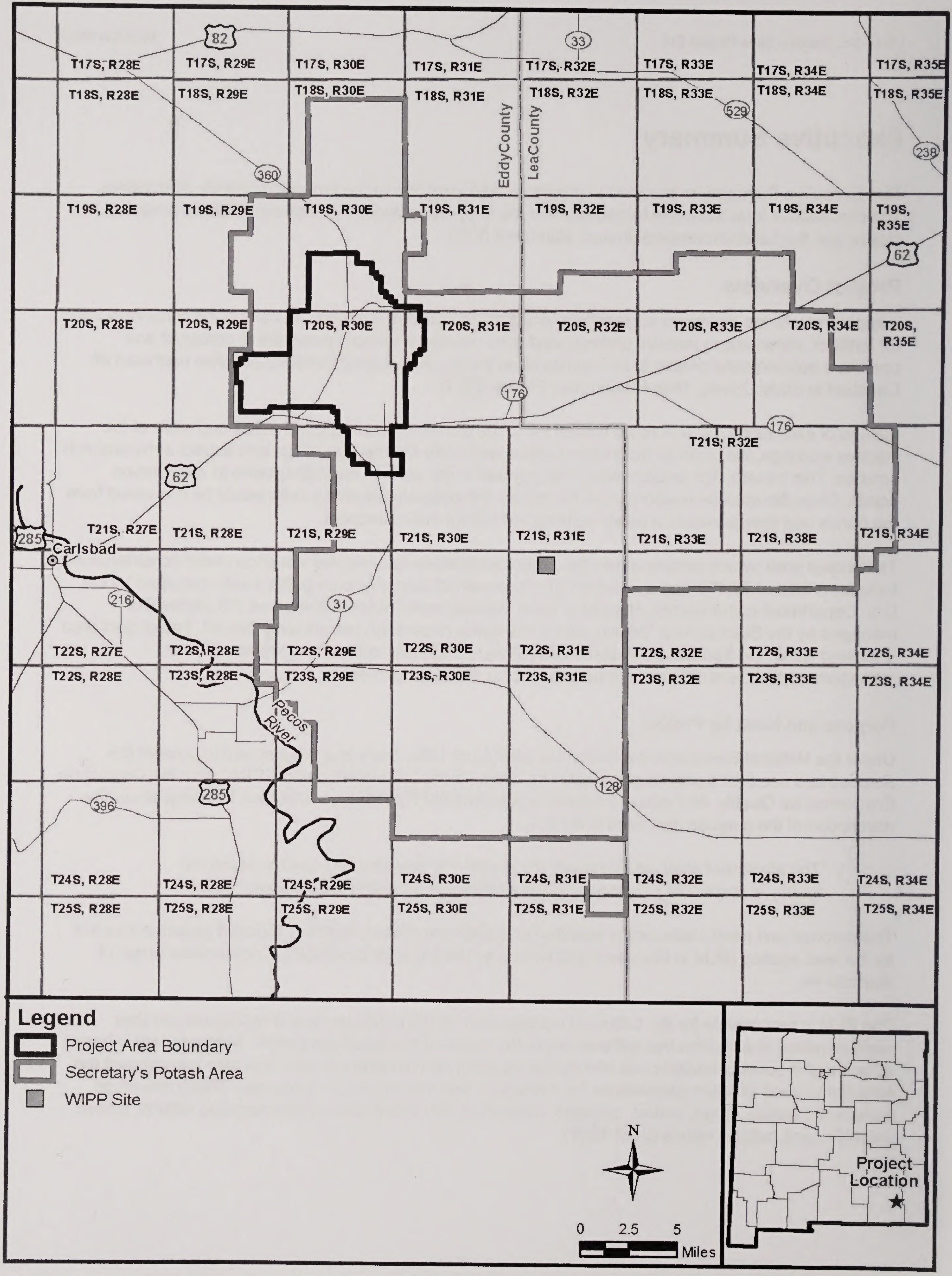

Figure ES-1. General Location of HB In-Situ Solution Mine Project Area

Potash is an important industrial mineral in wide demand in the U.S. The BLM has the responsibility to promote the orderly and efficient development and the maximum recovery of leasable minerals, including potash, as specified under 30 United States Code (USC) Chapter 2 §21a, the Mineral Leasing Act of 1920 as amended, the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1761), and the Secretary of the Interior's 1986 Potash Order (51 *Federal Register* 39425, October 28, 1986). The BLM has the duty to allow and encourage leaseholders to develop their leases subject to reasonable restrictions.

The BLM will evaluate and respond to Intrepid's proposal (Proposed Action) to construct, operate, maintain, and decommission an in-situ solution mining operation, including approval of the mine operation plan, rights-of-way (ROWs), and lease modifications.

The purpose of this project is to provide for technically viable development of the potash resources, as required by federal law and the federal leases and to allow the lessee to exercise its right to develop its leases subject to applicable mine and safety laws and the 1986 Order.

The proposed project would:

1. Further develop a potash mining operation by utilizing an in-situ solution mining technique that allows for the recovery of additional ore.
2. Extract the maximum technically feasible quantity of potash from inactive workings (HB Eddy, HB South, HB North, and HB Crescent) in accordance with mining and safety regulations.

Decisions to be Made

This EIS provides the analysis upon which the BLM can base its decisions. The decisions to be made by the BLM are:

1. Whether to approve Intrepid's HB In-Situ Solution Mine Operation and Closure Plan, requested ROWs, and lease modifications, and if so, under what terms and conditions.
2. If in-situ solution mining is approved by the BLM, a further decision is how to modify Intrepid's potash leases to be in compliance with the allowable acreage stated in 43 CFR §3503.37, as amended. Intrepid's leases that cover the proposed solution mining will be changed from conventional to solution mining leases and that acreage will not be counted against the 96,000-acre cap. Acreage changes would be calculated based on one of the following scenarios.
   - Add the acreage of all leases underlain by the flood pool for in-situ solution mining (3,644 acres under the Proposed Action).
   - Add the acreage of all HB Potash leases in the project area (22,189 acres).
   - Add the acreage of all leases, in their entirety, which touch the flood area (12,867 acres).

Public Participation

Scoping

The Notice of Intent to prepare an EIS for the HB In-Situ Solution Mine Project was published in the Federal Register on January 12, 2010. Two public scoping meetings were held on January 26, 2010, to collect comments on the proposed project.

By the end of the 30-day public scoping period, BLM received a total of 17 comment submittals (e.g., letter, comment form, verbal comments) containing 133 individual comments. The comments were compiled and analyzed to identify issues and concerns.

A majority of the comments received during the scoping period were related to the potential impacts associated with solution mining processes, potential impacts to groundwater, the potential for subsidence, and potential impacts to oil and gas exploration and operations. The number of comments by category is provided in **Table ES-1**.

A cooperating agency is typically invited to participate in NEPA projects because it has "special expertise," as defined in CEQ's NEPA regulations at 40 CFR 1508.26. On December 21, 2010, the BLM mailed letters of invitation for cooperating agency status to 42 tribes, pueblos, and federal, state, and local government agencies. Five local governments, two state agencies, and one federal agency have requested cooperating agency status, all of which have signed agreements.

Table ES-1 Comments Received by Category

Category Name	# of Comments
Alternatives	5
Biological Resources	12
Cumulative Impacts	2
Geology	6
Health/Safety	3
Land Ownership/Adjustment	1
Leasing	3
Livestock Grazing/Range Management	3
Mining	26
Mitigation Measures	5
Monitoring	3
NEPA Process	8
Noise	1
Oil and Gas	28
Out of Scope	2
Project Description	21
Public Involvement	2
Reclamation	2
Requests for Information	1
RMP Consistency	1
Socioeconomics	2
Subsidence	19
Surface Disturbance	2
Threatened and Endangered Species	1
Vegetation/Botany	1
Water Resources	40
Wildlife	5
Total	**205**

Draft EIS

The Notice of Availability (NOA) for the Draft EIS was published in the *Federal Register* on April 15, 2011. This began the 60-day period for public review and comment of the Draft EIS. Prior to publication of the NOA, BLM mailed the second project Bulletin to 111 people who indicated that they wanted to be on the mailing list. BLM mailed hard copies of the Draft EIS to nine people or agencies and 62 electronic copies on CD, based on requests and agency policy. E-mail notification of the NOA and the availability of the Draft EIS for downloading from the project website were sent to 55 people who provided addresses.

Two public meetings were held from 3:00 p.m. to 7:00 p.m., one each in Carlsbad (May 10, 2011) and Hobbs (May 11, 2011), New Mexico. The meetings were publicized through the project website, public service announcements to local radio and television stations, and through display advertisements in Artesia Daily Press, Hobbs News-Sun, and Carlsbad Current-Argus. The meetings began with a formal presentation to the public to ensure that meeting attendees were informed about the project and the findings in the Draft EIS. The presentation was followed by an informal open house to allow meeting attendees to ask questions and submit comments. BLM representatives staffed information stations with display boards showing the alternatives analyzed in detail, some of the key findings from the impact analysis, and information on the NEPA process. Sixty members of the public attended the Carlsbad meeting and 18 people attended the Hobbs meeting.

In response to a request from one agency, BLM extended the public comment period by two weeks, closing on June 23, 2011 instead of June 13 as originally scheduled. BLM received 27 distinct comment letters and 139 form letters from which there were 217 unique comments that were categorized.

Tribal Consultation

On February 1, 2010, the BLM-Carlsbad Field Office sent letters to the following pueblos and tribes notifying them of the proposed HB In-Situ Solution Mine project:

- Apache Tribe of Oklahoma
- Comanche Indian Tribe
- Hopi Tribe
- Kiowa Tribe of Oklahoma
- Mescalero Apache Tribe
- Pueblo of Isleta
- Ysleta del Sur Pueblo

The BLM received responses from the Pueblo of Isleta and the Ysleta del Sur Pueblo. Both Pueblos stated that the project will not impact either Pueblos' religious or cultural sites; however, should discoveries be found during project construction, notification of findings would be appreciated. The BLM intends to continue consultation throughout the environmental review and construction phase of the Preferred Alternative, if approved. Renewed contacts with some or all of the tribes may result if there are unanticipated discoveries.

Proposed Action and Alternatives

No Action

The No Action Alternative would deny the approval of the proposed project and would not modify the existing potash leases. Current land and resource uses would continue under current conditions in the project area.

Alternative A—Proposed Action

The Proposed Action would include approval of Intrepid's mine operation and closure plan, granting new ROWs, approval of permits to drill new water supply, injection, extraction, and monitoring wells, and approval of required lease modifications. Following is a brief summary of Intrepid's proposed operations, projected to function for 28 years.

- Pumping and conditioning of groundwater from seven Rustler Formation wells to form an injectate solution.
- Transport of the injectate through a surface piping system and injection of the solution through six wells into the lower portions of four separate former underground mine workings.
- Extraction of the resulting pregnant brine from the underground mine workings through five extraction wells.
- Pumping the brine through above-ground pipelines to evaporation ponds where the potassium and sodium salts (KCl and NaCl, respectively) would be precipitated.
- Harvest of precipitated potash and salt from the evaporation ponds and transport to a new flotation mill (HB Mill).
- Refinement of ore to marketable potash product at the new HB Mill and the existing Intrepid North Plant. Recycling of NaCl tailings to condition the injection source groundwater to be used for injectate.
- At the completion of the project, all project components and all disturbed areas would be reclaimed and infrastructure would be decommissioned.

Alternative B—Supplemental Water Sources

This alternative would include approval of Intrepid's HB In-Situ Solution Mine Operation and Closure Plan, granting new ROWs, approval of required lease modifications, and approval of permits to drill new water supply, injection, extraction, and monitoring wells. Additional water sources from Intrepid's Caprock wells east of the project area would be used to supplement the saline water whenever the Rustler water supply is inadequate to meet the optimum filling rate of the flood pools. Intrepid's existing pipelines from the Caprock wells would be improved. Fewer Rustler wells and pipelines would be developed, but all of the other facilities and process plans would be the same as the Proposed Action.

Alternative C—Buried Pipelines

This alternative would approve Intrepid's HB In-Situ Solution Mine Operation and Closure Plan, grant ROWs with modifications designed to limit surface facilities, approve permits for new water supply, injection, extraction, and monitoring wells, and approve required lease modifications. Intrepid's proposal would be modified to bury all pipelines. The layout of the pipeline system would be the same as that described for Alternative A, Proposed Action.

Preferred Alternative

According to CEQ's NEPA regulations at 40 CFR Section 1502.14(e), the agency's preferred alternative should be identified in the Final EIS. This alternative must fulfill the BLM's mission and responsibilities, while giving consideration to economic, environmental, technical, and other factors. The BLM, as the decision-maker, selected aspects of Alternatives A, B, and C to develop the Preferred Alternative. This alternative includes approval of Intrepid's revised HB In-Situ Solution Mine Operation and Closure Plan, granting new ROWs, approval of lease modifications to remove 12,867 acres from the 96,000-acre conventional mining lease limit per state, and approval of permits to drill new water supply, injection, extraction, and monitoring wells. The overall footprint of the evaporation ponds would increase by 62 acres. There would be minor changes to the layout of the pipelines in the project area to avoid karst features and improve the efficiency of layouts for a variety of reasons. Approximately 68 percent of the pipeline bundles would be buried. Within the project area, four Rustler wells would be developed and additional water sources from Intrepid's Caprock wells east of the project area would be used to supplement the required water quantity whenever the Rustler water supply is inadequate to meet the optimum filling rate of the flood pools. A new pipeline from the Caprock wells would be installed along an alignment designed to avoid sand dune lizard habitat. All of the process plans would be the same as the Proposed Action.

Environmental Consequences

The resource-specific effects of the alternatives analyzed in detail (No Action, Proposed Action, Alternative B, and Alternative C) were evaluated quantitatively and qualitatively, as appropriate based on available data and the nature of the resource analyzed. Detailed descriptions of impacts are presented for each alternative in Chapter 4.0. A summary of the key points of the conclusions from the impact analyses is provided in **Table ES-2**. Detailed descriptions of impacts are presented for each alternative in Chapter 4.0. The summarized impacts assume the implementation of applicant-committed environmental protection measures and the BLM required environmental protection measures. However, it is not assumed that the recommended mitigation measures would be implemented. Implementation of the recommended mitigation measures identified in Chapter 4.0 potentially would further reduce impacts.

Cumulative Impacts

Cumulative impacts are the combination of the individual effects of multiple actions over time in the context of other development in the project area or the region. The individual effects may be minor when considered separately, but may be major or significant when considered in combination with all others in the region. Cumulative impacts from past, present, and reasonably foreseeable development are presented in Chapter 5.0. For each resource, the Cumulative Effects Study Area (CESA) was developed appropriate to the geographical extent of anticipated impacts.

The cumulative impact analysis focused primarily on reasonably foreseeable future actions that were known by the BLM at the time the analysis was performed. The list, provided in **Table ES-3**, includes actions that are likely to affect the same resources that were analyzed in Chapter 4.0. Their impacts on the region were considered in combination with the proposed HB In-Situ Solution Mine Project to predict the potential cumulative effects of all actions combined on each of the resources analyzed in the EIS.

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Geology and Minerals					
Subsidence Hazards	Natural and historical mine-related subsidence likely to continue.	Increased potential for mining-related subsidence as more potash is removed. Maximum subsidence is 0.6 foot.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed.
Caves	No impact other than from ongoing natural and historical mine-related subsidence that may affect caves.	New access roads may increase public access of caves. Small chance that drilling into unrecorded cave/karst features may allow fresh water to enter the groundwater system or dissolve evaporite strata. 42 to 43 known caves in the project area may be affected by drawdown.	New access roads may increase public access of caves. Small chance that drilling into unrecorded cave/karst features may allow fresh water to enter the groundwater system or dissolve evaporite strata. 18 to 38 known caves in the project area may be affected by drawdown.	Same as Proposed Action.	Same as Alternative B.
Minerals	No additional potash would be recovered from inactive workings and maximum recovery of the mineral resource would not be achieved. Intrepid's conventionally mined potash leases would not exceed 96,000 acres in New Mexico.	Additional potash reserves would be recovered and the maximum recovery of the mineral resource would be achieved. The total acreage of Intrepid's potash leases may increase.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Oil and Gas	There would be no change to oil and gas's existing access to fluid minerals in the project area.	Oil and gas access to fluid minerals in the project area would not be affected.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Paleontological Resources	Potential impacts are small.	Potential impacts are small, but may increase as public access to the area increases due to new roads.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Water					
Subwatersheds most affected by surface disturbance	None.	Clayton Basin and Maroon Cliffs.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Number of locations where surface pipelines block drainages, increasing potential erosion	None.	9	Same as Proposed Action.	0	6
Maximum Rustler area drawdown depth and acreage	No impact.	200 feet; 1,850 to 6,500 acres, depending on Rustler model used.	0 to 200 feet, depending on water source used. 200-foot drawdown contour encompasses between 1,450 and 4,750 acres, depending on Rustler model used.	Same as Proposed Action.	Same as Alternative B.
Maximum seep/spring reduction	No impact.	64%	31%	Same as Proposed Action.	Same as Alternative B.
Maximum Nash Draw flux reduction	No impact.	35%	25%	Same as Proposed Action.	Same as Alternative B.
Maximum Caprock area drawdown	No impact.	8 feet	52 feet	Same as Proposed Action.	Same as Alternative B.

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Maximum Caprock area drawdown over life of project	No impact.	8 feet	34 feet	Same as Proposed Action.	Same as Alternative B.
Soils					
Low revegetation potential soils disturbed	None.	792 acres	Max. 1,145 acres (existing Caprock pipeline option)	Same as Proposed Action.	862 acres
High wind erosion soils disturbed	None.	216 acres	Max. 357 acres (existing Caprock pipeline option)	Same as Proposed Action.	284 acres
Air Quality					
New HB mill emissions	None.	No exceedance of ambient air quality standards or PSD increment. PM_{10}=11.8 tpy; NO_X=12 tpy; SO_2=0.07; VOC=0.7	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
State and federal ambient air quality standards	No impacts.	Not exceeded by fugitive or stationary sources. Total project NO_X emissions <0.001% of current Eddy County emissions.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Sensitive areas	No impacts.	Not affected by emissions from project.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Climate Change					
Greenhouse gas CO_2 equivalent emissions	None.	Negligible impacts to global climate change from construction and project operations.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Vegetation					
Vegetation types disturbed (acres)	None.	Mesquite Upland Scrub: 597 acres: Desert Scrub: 346 acres; Grassland: 44 acres.	Existing Caprock pipeline replacement: Mesquite Upland Scrub: 803 acres: Desert Scrub: 387 acres; Grassland: 154 acres. New Caprock Pipeline: Mesquite Upland Scrub: 736 acres: Desert Scrub: 377 acres; Grassland: 142 acres.	Same as Proposed Action.	New Caprock pipeline replacement: Mesquite Upland Scrub: 723 acres: Desert Scrub: 404 acres; Grassland: 142 acres.
Vegetation types most affected by groundwater drawdown (acres)	None.	Mesquite Upland Scrub: 5,932 – 6,044 acres: Desert Scrub: 2,561 – 2,622 acres; Grassland: 836 – 840 acres; Woody Riparian: 639 – 655 acres.	Mesquite Upland Scrub: 1,332 – 3,282 acres: Desert Scrub: 483 – 1,579 acres; Grassland: 738 – 425 acres; Woody Riparian: 6 – 56 acres.	Same as Proposed Action.	Same as Alternative B.
Sensitive plant species habitat potentially affected	None.	Scheer's beehive cactus: 377 acres; gypsum wild buckwheat: 128 acres.	Existing Caprock pipeline: Scheer's beehive cactus: 420 acres; gypsum wild buckwheat: 138 acres New Caprock pipeline: Scheer's beehive cactus: 420 acres; gypsum wild buckwheat: 138 acres	Same as Proposed Action.	New Caprock pipeline Scheer's beehive cactus: 443 acres; gypsum wild buckwheat: 135 acres

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Wildlife and Fish					
Terrestrial wildlife habitat	None.	Impacts from surface disturbance, habitat disruption, and fragmentation would be relatively minor. Less mobile small game and nongame species likely to be the most affected by surface disturbance and blockage of movements due to surface pipelines. Significant potential adverse impacts to migratory birds from exposure to evaporation pond water unless mitigation measures are implemented.	Same as Proposed Action.	Same as Proposed action with no wildlife movement blockages due since pipelines will be buried.	Same as Proposed Action with less wildlife movement blockages due to fewer and more strategically placed surface pipelines.
Sensitive Species	None.	The seven bat species, burrowing owl, loggerhead shrike, and sand dune lizard may be affected by changes to the scrub, grass, and woody riparian vegetation types due to surface disturbance or groundwater drawdown. Changes to grasslands would primarily affect the habitat of the swift fox, Baird's sparrow, lesser prairie-chicken, gray vireo, and Texas horned lizard. Impacts would be minor due to availability of similar cover types nearby.	Impacts similar to the Proposed Action, except that there is greater potential for adverse impacts to sand dune lizards and lesser prairie-chickens. However, these impacts would be minimized by implementation of the BLM's required environmental protection measures.	Same as Proposed Action.	Same as Alternative B; however, pipelines have been rerouted to avoid sand dune lizard habitat to avoid potential for adverse impacts.

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Rangelands/ Livestock Grazing					
Animal unit months (AUMs) lost due to permanent facilities	No new disturbance.	125 AUMs lost; most (86) in Maroon Cliffs allotment. Most AUM reductions would occur on private land.	Existing Caprock pipeline option: 173 AUMs lost; most (88) in Maroon Cliffs allotment. New Caprock pipeline option: 152 AUMs lost; most (86) in Maroon Cliffs allotment Most AUM reductions would occur on private land.	Same as Proposed Action.	148 AUMs lost; most (88) in Maroon Cliffs allotment. Most AUM reductions would occur on private land.
Lands and Realty					
Effect on other land uses	None.	Temporary minor impacts on vehicle traffic in and near project area during construction; aboveground pipelines may affect land user travel and other land uses in the future.	Same as Proposed Action.	Temporary minor impacts on vehicle traffic in and near project area during construction.	Same as Proposed Action; however, 68% of the pipelines would be buried.
Recreation					
Effect on recreational uses	No additional disturbance.	5% of Hackberry SRMA acreage within potential subsidence area; increased public access by vehicles due to new roads; aboveground pipelines may obstruct OHV trails. Construction and operation activities may disrupt dispersed recreational users.	Same as Proposed Action.	5% of Hackberry SRMA acreage within potential subsidence area; increased public access by vehicles due to new roads. Construction and operation activities may disrupt dispersed recreational users.	Same as Proposed Action; however, 68% of the pipelines would be buried. All of the pipeline within Hackberry SRMA would be buried, resulting in fewer changes to OHV trails and access.

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Visual Resources					
Viewshed modifications	No change.	Slight to moderate modifications of the viewshed by the addition of man-made features. In compliance with VRM Class IV management.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Cultural Resources					
Effect on archaeological sites	None.	Potential direct effects to National Register of Historic Places (NRHP)-eligible sites from construction would be avoided or mitigated through data recovery. Potential loss of ineligible sites. Increased public access may result in more illegal collecting.	Same as Proposed Action.	Same as Proposed Action	Same as Proposed Action.
Hazardous Materials, Health and Safety					
Emergency plans	Existing emergency response and spill plans.	Development of new emergency response and spills plans, new health and safety training for new employees.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Socioeconomics, Environmental Justice					
Total Employment (# of employees)	629 current existing employees at Intrepid facilities near the project area.	In addition to existing work force: Short-term (peak) : 274 Long-term: 36	In addition to existing employees: Short-term (peak): 285 Long-term: 36	Slightly higher than the Proposed Action, fewer than Alternative B.	In addition to existing work force: Short-term (peak) : 272 Long-term: 36

Table ES-2 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Indirect or Induced employment	N/A.	Short-term average: 194 Long-term: 19	Short-term average: 204 Long-term: 19	Slightly higher than the Proposed Action, fewer than Alternative B.	Same as the Proposed Action, but longer duration
Population changes	None.	+Short term: Up to 221 for construction Long term: +24 for operations.	+Short term: Up to 233 for construction Long term +24 for operations.	Same as Alternative B	Same as the Proposed Action
Housing demands	None.	Short term: Peak of 140 units, mostly motel rooms, RV camp sites and apartments in Carlsbad Long term: 10 units	Short term peak of 147 units, primarily in Carlsbad Long term10 units	Slightly higher than the Proposed Action, fewer than Alternative B.	Same as Proposed Action.
Federal mineral royalties, annual	No change.	Between $2.3 million and $4.7 million in addition to existing for potash production.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Local property taxes, annual	No change.	Between $0.53 million and $1.05 million annually.	Slightly higher than Proposed Action due to higher capital investment.	Same as Alternative B.	Same as Alternative B.
Gross receipts, personal and corporate income taxes; life of project	No change	As much as $9.8 million in addition to those from existing operations	Slightly higher than the Proposed Action	Slightly higher than the Proposed Action, lower than Alternative B.	Same as Alternative B
Environmental justice	No disproportionate adverse effects on minority or low-income populations.	Same as No Action.	Same as No Action.	Same as No Action.	Same as No Action.

Table ES-3 Reasonably Foreseeable Future Actions in the Region

Project	Brief Description	Approximate Location
1. Intrepid water-saving improvements	Planned upgrades to Intrepid's East Mine langbeinite process plant, projected to be completed by the end of 2011, anticipated to decrease Caprock water usage by approximately 700 to 800 gpm.	Intrepid East Mill
2. Polyhalite mining project	Intercontinental Potash is proposing a polyhalite mining operation on state and federal mineral leases and surface. The planned extraction method is underground room and pillar mining approximately 1,500 feet below the surface. Exploratory drilling is ongoing to evaluate the extent and quality of the potash formations. Water for processing is proposed to come from the Capitan Aquifer.	In five townships in Lea County, New Mexico, approximately 9 miles from the eastern boundary of the SPA
3. BLM vegetation management	As part of the Restore New Mexico program, the BLM plans several chemical treatments to manage invasive plants (mesquite and creosote). No surface disturbance is planned.	Within and near project area
4. Construction and maintenance for recreation	There is a proposal to construct a new parking lot in the Hackberry Recreation Area, approximately 0.5 to 1 acre in size. Trail maintenance is ongoing and involves little, if any, surface disturbance.	Hackberry Recreation Area
5. Creamer water project	A private landowner is proposing to develop a well on state land to supply saline water for sale to the oil and gas industry. The water may be coming from the Rustler Formation. Also proposing a pipeline running north up a small dirt road, crossing under the highway and ending at an old caliche pit where storage tanks would be installed.	Section 2, T20S, R30E (southeast of Clayton Lake)
6. Oil and gas drilling and production	Oil and gas drilling of new wells and production from existing wells would continue in the SPA according to BLM policy and approval. It is anticipated that oil and gas drilling operations would continue at the current rate of 75 per year in the SPA and an average of 1 per year within the project area. An average of 3.5 acres would be disturbed for each new well pad constructed.	In the SPA and project area

Table ES-3 Reasonably Foreseeable Future Actions in the Region

Project	Brief Description	Approximate Location
7. Derrick well	Intrepid recently converted an old core hole to a water supply well in the vicinity of the Rustler wells proposed for the project. The well extracts from the Rustler Formation, using the same source as the proposed new Rustler wells. Intrepid anticipates using this well at a rate of approximately 20 gpm to supplement processing water at the West Plant.	Section 1, T21S, R29E

Below is a summary of the projected cumulative impacts for key resources:

Geology and Minerals—Mining Subsidence

The CESA for mining subsidence is the project area. The proposed project and alternatives would result in approximately 4,354 acres of area at risk for additional subsidence. The additional subsidence due to solution mining is expected to be about 0.6 foot. Other projects in the vicinity of the project area are not anticipated to add to this projected subsidence amount or area. The proposed polyhalite mine would most likely contribute to regional subsidence due to mining, but this project is far outside the project area and subsidence impacts would not occur until long into the future.

Geology and Minerals—Potash

The CESA for potash resources is southeast New Mexico including Lea and Eddy counties. The proposed solution mining project estimates that around 6,000,000 tons of sylvite ore would be removed (or roughly 3,780,000 tons of potassium oxide equivalent), which represents roughly 3 percent of the cumulative production as of 2009. Based on the USGS's estimate of 551 million short tons of resource (USGS 2009), the proposed solution mining recovery is a small fraction of the total remaining resource.

Geology and Minerals—Oil and Gas

The CESA for oil and gas is the Oil Potash Leasing Area (OPLA), defined by Oil Conservation Commission (OCC) Order R-111-P that encompasses most of the SPA. The HB In-Situ Solution Mine project area covers approximately 38,453 acres or about 11 percent of the OPLA. The use of horizontal drilling would enable access to oil and gas to be extracted without affecting the solution and conventional mining operations. The area encompassed by existing mine workings is large enough that directional drilling as a recovery method may be technically but not economically feasible in portions of the area. It would be reasonable to assume that economic constraints would limit the recovery of oil and gas resources in spite of technological advances. However, it may not be possible to estimate how much fluid minerals recovery would be lost or delayed until the end of potash mining. Production islands would continue to be established according to the procedures established by the 1986 Order and OCC Order R-111-P. The proposed project would not restrict oil and gas further than existing restrictions and would not prevent oil and gas exploration and production in the OPLA.

Water Resources—Groundwater

The CESA for groundwater resources is the SPA depicted in **Figure ES-1** and the Caprock area in western Lea County. Groundwater in the Clayton Basin will potentially be utilized by both the Proposed Action and the Creamer Project. The Creamer Project has been proposed by a private land owner to develop a well on state land to supply saline water for sale to the oil and gas industry. If both projects withdraw water from the Clayton Basin, overall drawdown would be greater than the estimated drawdown impacts estimated for the Proposed Action. The Creamer Project withdrawal quantities are unknown at this time. Water withdrawn from the Caprock area would decrease under Intrepid's water-saving improvements at its East Mine process plant. The water savings would offset Caprock pumping under the Proposed Action, and would lessen the pumping impacts discussed under the Alternative B and Preferred Alternative pumping scenarios. Water withdrawn from the Derrick well would potentially limit the amount of Rustler water available for the HB In-Situ Solution Mine Project because there is a limited amount of water available for use from the Rustler but would not increase overall drawdown projected for the project area. Water needed for the proposed Intercontinental Potash polyhalite mine operation is proposed to come from a different aquifer than those proposed for the HB In-Situ Solution Mine Project so it is unlikely to change the regional groundwater drawdown or availability of water for other uses.

Water Resources—Surface Water

The CESA for surface water resources is the project area and nearby watersheds. Cumulative impacts to surface water resources primarily would be directly related to ground disturbance from construction for additional mining and oil and gas development because it may contribute to erosion and sedimentation. Up to approximately 260 acres may be disturbed annually from oil and gas development (less than 0.1 percent of the area). Additional minor disturbance would occur from the Creamer Project if a supply pipeline and storage tanks were constructed and from the proposed Hackberry SRMA parking lot. Because the surface disturbance would be scattered throughout the SPA and would be stabilized according to BLM requirements, this additional surface disturbance, in combination with the proposed in-situ solution mine project, would not have a major impact on surface water quality.

Acronyms and Abbreviations

°F	degrees Fahrenheit
μg/m^3	micrograms per cubic meter
AAQS	Ambient Air Quality Standards
ACGIH	American Council of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
afy	acre feet per year
AGFD	Arizona Game and Fish Department
AIRFA	American Indian Religious Freedom Act of 1978
APD	Application for Permit to Drill
APE	area of potential effect
AQCR	air quality control region
AQRV	air quality related values
ARPA	Archaeological Resources Protection Act of 1979
AUM	animal unit month
BISON-M	Biota Information System of New Mexico
BLM	Bureau of Land Management
BMP	Best Management Practices
BOE	barrels of oil equivalent
bpd	barrels per day
Btu	British thermal unit
CAA	Clean Air Act
CBG	Census Block Group
CEHMM	Center of Excellence for Hazardous Material Management
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	cumulative effects study area
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CWA	Clean Water Act of 1972
EA	Environmental Assessment

EIS	Environmental Impact Statement
EO	Executive Order
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLETC	Federal Law Enforcement Training Center
FLM	Federal Land Manager
FLPMA	Federal Land Policy and Management Act of 1976
GHG	greenhouse gas
GIS	Geographic Information System
gpd	gallons per day
gpm	gallons per minute
GRT	gross receipts tax
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid
HAP	hazardous air pollutant
HDPE	high density polyethylene
HUC	Hydrologic Unit Code
Intrepid	Intrepid Potash, Inc.
IPCC	Intergovernmental Panel on Climate Change
K_2O	potassium oxide
KCl	potassium chloride
kg	kilogram
km	kilometer
kWh	kilowatt-hours
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act
MCF	1,000 cubic feet of gas
mg/L	milligrams per liter
MgCl	magnesium chloride
MLRA	Major Land Resource Area
MMBtu/hr	million British thermal unit per hour
MMPA	Mining and Mineral Policy Act of 1970
mph	miles per hour

MSHA	Mine Safety and Health Administration
msl	mean sea level
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NaCl	sodium chloride
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NEF	National Enrichment Facility
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act of 1986
NMAAQS	New Mexico Ambient Air Quality Standards
NMAC	New Mexico Administrative Code
NMACP	New Mexico Avian Conservation Partners
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMDA	New Mexico Department of Agriculture
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMED-AQB	New Mexico Environment Department-Air Quality Bureau
NMOSE	New Mexico Office of the State Engineer
NMRPTC	New Mexico Rare Plant Technical Council
NMSA	New Mexico Statutes Annotated
NMSU	New Mexico State University
NMWQCC	New Mexico Water Quality Control Commission
NO_2	nitrogen dioxide
NOI	Notice of Intent
NO_X	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSR	New Source Review
NWI	National Wetland Inventory
NWMA	Noxious Weeds Management Act
NWR	National Wildlife Refuge

O_3	ozone
OCC	Oil Conservation Commission
OCD	Oil Conservation Division, New Mexico Energy, Minerals and Natural Resources Department
OEL	Occupational Exposure Level
OHV	off-highway vehicle
OPLA	Oil Potash Leasing Area
OSHA	Occupational Safety and Health Administration
Pb	lead
PCA	Potash Corporation of America
PFYC	Potential Fossil Yield Classification
PILT	Payments in lieu of tax
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
ppm	parts per million
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
PTI	pilot/test/instrumentation
R	Range (Public Land Survey System)
RCRA	Resource Conservation and Recovery Act
REL	Reference Exposure Level
RfC	reference concentrations
RFFA	reasonably foreseeable future action
RMP	Resource Management Plan
RMPA	Resource Management Plan Amendment
ROD	Record of Decision
ROW	right-of-way
RV	recreational vehicle
SARA	Superfund Amendments and Reauthorization Act
scf	standard cubic feet
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SPA	Secretary’s Potash Area
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
SRMA	Special Recreation Management Area

SSURGO	Soil Survey Geographic Database
SWD	salt water disposal
SWPPP	Storm Water Pollution Prevention Plan
SWReGAP	Southwest Regional Gap Analysis Project
T	Township (Public Land Survey System)
TCP	Traditional Cultural Property
TDS	total dissolved solids
Tg	teragrams
tpy	tons per year
TSL	toxic screening level
TSP	total suspended particulate
U.S.	United States
UNM-BBER	University of New Mexico Bureau of Business and Economic Research
USBEA	U.S. Bureau of Economic Analysis
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFD	volunteer fire department
VOC	volatile organic compound
VRM	Visual Resource Management
WBD	Watershed Boundary Dataset
WIPP	Waste Isolation Pilot Plant
WRCC	Western Regional Climate Center

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1.0 Introduction

1.1 Brief Project Description

Intrepid Potash, Inc. (Intrepid) is proposing to extract the potash, a potassium compound commonly used for fertilizer, remaining in inactive underground mine workings using solution mining. Intrepid proposes to construct and operate a solution mine project in an existing deep mine located approximately 20 miles northeast of Carlsbad in Eddy County, New Mexico (see **Figure 1-1**).

Instead of excavating the remaining potash left in the remaining underground pillars and walls of the inactive workings, the process would inject saline water into the mine workings and extract a mineral-rich solution. This mineral-rich solution would be pumped to the surface and transported to evaporation ponds. Once the solution evaporates in the ponds, the potassium-bearing salts would be harvested from the ponds and transported to a newly constructed mill for ore refinement.

The project area, which encompasses the proposed facilities and inactive workings under consideration, includes a total of 38,453 acres, of which 31,439 acres (82 percent) is on public lands managed by the U.S. Department of the Interior (USDI), Bureau of Land Management (BLM), 4,954 acres (13 percent) is managed by the State of New Mexico, and 2,060 acres (5 percent) are privately owned.

1.1.1 Background

Potash is the term used to describe compounds of potassium that occur in combination with other compounds including magnesium, sodium, chloride, sulfate, and nitrate in varying quantities. Most potash is used for agricultural fertilizer, but other uses include pharmaceuticals, salt substitutes, soap, glass, and batteries (Barker et al. 2008).

Commercial potash reserves occur in New Mexico primarily within the Secretary's Potash Area (SPA), first designated in 1939 when the federal government, through an order by the Secretary of the Interior, withdrew 2,560 acres from oil and gas leasing in deference to potash mining (1939 Order). The 1939 Order remained in effect until 1951, at which time the Secretary of the Interior issued a new Order allowing for concurrent operations in the prospecting and development and production of oil and gas and potash deposits owned by the U.S. A succession of orders followed (1951, 1965, 1975, and 1986), expanding the SPA each time. On October 21, 1986, the Order of the Secretary of the Interior (51 *Federal Register* 39425, October 28, 1986), titled "Oil, Gas and Potash Leasing and Development Within the Designated Potash Area of Eddy and Lea Counties, New Mexico" expanded the SPA to 497,002 acres. Commonly referred to as the 1986 Order, it governs the current management of federal oil, gas, and potash leasing and development within the SPA.

The potash mines and most of the land affected by the proposed project are located on land managed by the BLM. Under the requirements of the federal National Environmental Policy Act (NEPA) of 1969, an environmental impact statement (EIS) must be prepared for major federal actions that may have a significant effect on the environment. The BLM Carlsbad Field Office has determined that an EIS is required to analyze the potential environmental impacts of the proposed project before the agency makes a decision on whether to allow the proposed project to proceed.

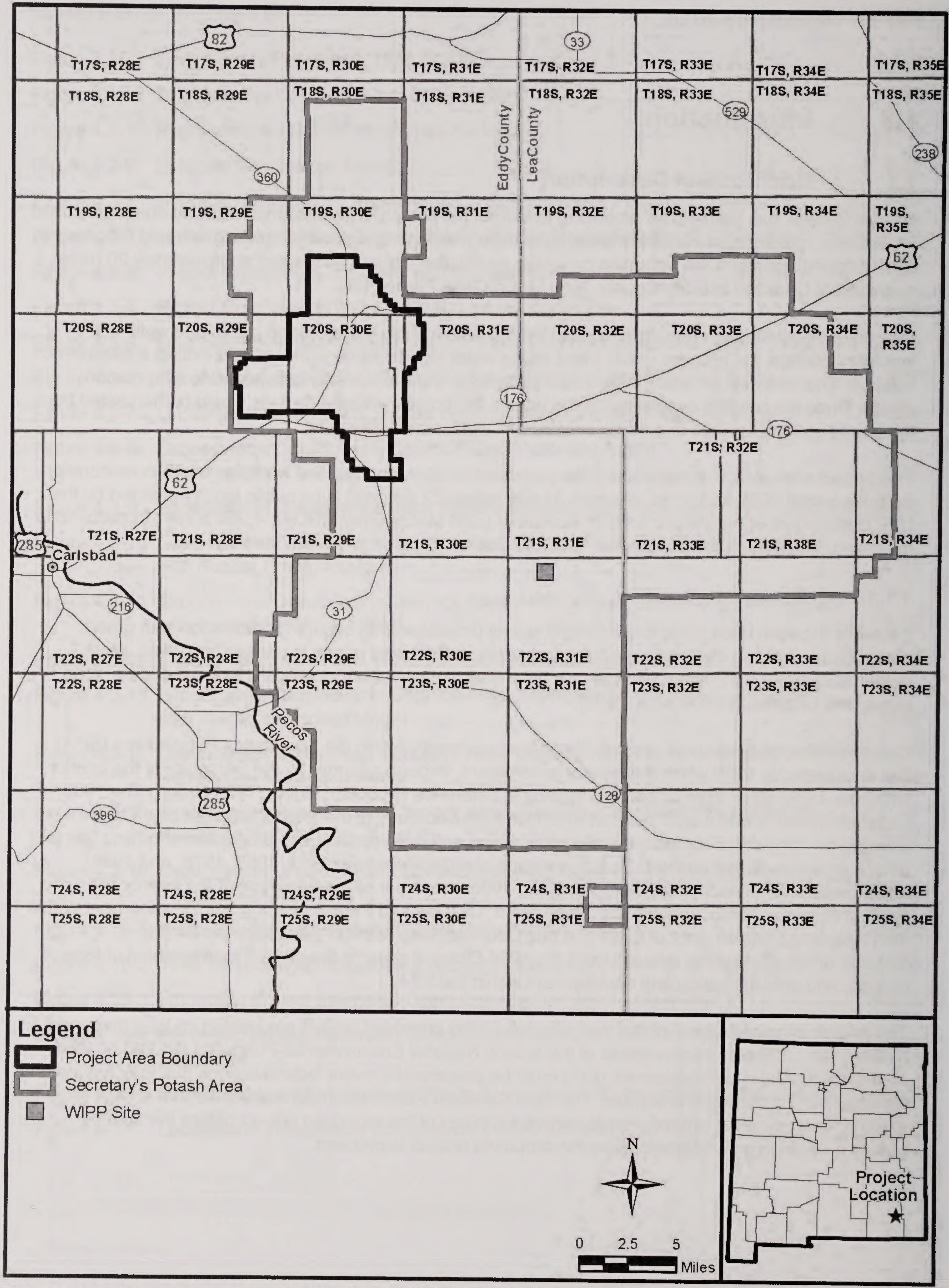

Figure 1-1. General Location of HB In-Situ Solution Mine Project Area

1.2 Purpose and Need for the Project

Under the NEPA, there is a requirement to present the purpose and need for a proposed project. The "Regulations for Implementing NEPA" from the Council on Environmental Quality (CEQ), 40 Code of Federal Regulations (CFR) §1502.13, state the following about the description of the purpose and need in an EIS.

> *"The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action."*

The purpose and need statement is intended to explain the reason that the proposed project is needed by the lead agency (the BLM in this case) and serves as the basis for developing a reasonable range of alternatives.

The BLM is responsible for the balanced management of the public lands and resources and its various values in a fashion that will best serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield; combinations of uses that take into account the long-term needs of future generations for renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife, wilderness and natural, scenic, scientific, and cultural values (BLM 1997).

Potash is an important industrial mineral in wide demand in the U.S. The BLM has the responsibility to promote the orderly and efficient development and maximum recovery of leasable minerals, including potash, as specified under 30 United States Code (USC) Chapter 2 §21a, the Mineral Leasing Act of 1920 as amended, the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1761), and the Secretary of the Interior's 1986 Potash Order (51 *Federal Register* 39425, October 28, 1986). The BLM has the duty to allow and encourage leaseholders to develop their leases subject to reasonable restrictions.

The BLM will evaluate and respond to Intrepid's proposal (Proposed Action) to construct, operate, maintain, and decommission an in-situ solution mining operation, including approval of the mine operation plan, rights-of-way (ROWs), and lease modifications.

The purpose of this project is to provide for technically viable development of the potash resources, as required by federal law and the federal leases and to allow the lessee to exercise its right to develop its leases subject to applicable mine and safety laws and the 1986 Order.

The proposed project would:

1. Further develop a potash mining operation by utilizing an in-situ solution mining technique that allows for the recovery of additional ore.
2. Extract the maximum technically feasible quantity of potash from inactive workings (HB Eddy, HB South, HB North, and HB Crescent) in accordance with mining and safety regulations.

1.3 Decisions to be Made

This EIS provides the analysis upon which the BLM can base its decisions. The decisions to be made by the BLM are:

1. Whether to approve Intrepid's HB In-Situ Solution Mine Operation and Closure Plan, requested ROWs, and lease modifications, and if so, under what terms and conditions.
2. If in-situ solution mining is approved by the BLM, a further decision is how to modify Intrepid's potash leases to be in compliance with the allowable acreage stated in 43 CFR §3503.37, as

amended. Intrepid's leases that cover the proposed solution mining will be changed from conventional to solution mining leases and that acreage will not be counted against the 96,000-acre cap. Acreage changes would be calculated based on one of the following scenarios.

- Add the acreage of all leases underlain by the flood pool for in-situ solution mining (3,644 acres under the Proposed Action).
- Add the acreage of all HB Potash leases in the project area (22,189 acres).
- Add the acreage of all leases, in their entirety, which touch the flood area (12,867 acres).

1.4 Authorizing Laws and Regulations, Relationship to Policies, Plans, and Programs

1.4.1 Resource Management Plans

The BLM has the responsibility and authority to manage the surface and subsurface resources on public lands located within the jurisdiction of the Carlsbad Field Office. The Carlsbad Resource Management Plan (RMP) (BLM 1988) designated lands within the proposed project area as open for mineral exploration and development. Under Continuing Management Guidance for Energy and Mineral Resources, the RMP states that the "BLM will encourage and facilitate the development by private industry of public land mineral resources so that national and local needs are met, and environmentally sound exploration, extraction, and reclamation practices are used."

The RMPA for the Carlsbad Resource Area (BLM 1997) was prepared to address the management of oil and gas resources in the field office area. In general, it reiterates the goals of the 1986 Order for oil and gas drilling where there is potash mining. It states that drilling for oil and gas is allowed in the SPA if the drilling does not interfere with potash mining and does not create a hazard. It states that the infiltration of oil, gas, or water into potash deposits, mines, or workings must be prevented when wells are abandoned.

The Special Status Species RMPA for the BLM Pecos District Office (BLM 2007) was adopted to address specific management prescriptions to ensure the continued habitat protection of two special status species, the lesser prairie-chicken (*Tympanuchus pallidicinctus*) and the sand dune lizard (*Sceloporus arenicolus*).

1.4.2 Other Applicable Federal Laws and Regulations

The BLM authority for land management derives from the FLPMA. General BLM regulations are described in 43 CFR, Subtitle B—Regulations Relating to Public Lands, Chapter II—BLM, USDI. BLM regulations for the management of mining on federal potash leases are included in 43 CFR Subpart 3590, Solid Minerals (Other Than Coal) Exploration and Mining Operations—General. Subpart 3592.1, Operating Plans, specifies that before any operations are conducted under any lease, the operator must submit a detailed mine and reclamation plan to the BLM, which the BLM must approve before operations can begin. These regulations contain specific criteria that the mine and reclamation plan must address to assure the protection of nonmineral resources and the reclamation of the lands affected by the operations. It also requires coordination with state agencies.

Potash is a solid leasable mineral that is managed by the BLM under the authority of the Mineral Leasing Act of 1920, as amended, the Potash Leasing Act of 1927, and, in southeastern New Mexico, the 1986 Order. The Mineral Leasing Act establishes qualifications for mineral lessees, defines maximum limits on the total acres of a mineral that can be held by a lessee, and authorizes the BLM to grant these leases. Federal regulations that pertain to leasing these minerals are contained in 43 CFR Part 3500, Leasing of Solid Minerals Other than Coal and Oil Shale. The State of New Mexico's Order No. R-111-P (see **Appendix A**) applies to state lands and minerals in the area. While the BLM may incorporate elements of R-111-P into its management of the SPA, the BLM is not mandated to follow it. In particular, Life of Mine Reserves, as defined in R-111-P, are not used for management of federal lands and minerals.

The Mining and Mineral Policy Act of 1970 (MMPA) mandates that federal agencies ensure that closure and reclamation of mine operations be completed in an environmentally responsible manner. The MMPA states that the federal government should promote the "development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined lands, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining mineral activities."

Other major federal and state regulations and permits that are relevant to the proposed project include those listed in **Table 1-1**, which is not all-inclusive.

Table 1-1 Major Federal and State Law, Regulations, and Applicable Permits

Regulation	Brief Description	Applicable Permit or Action
NEPA (P.L. 91-190) and CEQ – Regulations for Implementing NEPA (40 CFR Parts 1500 – 1508)	Disclosure of the potential impacts of federal actions on the human environment to the decision makers and the public to ensure that informed decisions are based on science.	EIS
Clean Water Act (CWA) and Federal Water Pollution Control Act Amendments	Regulate discharge to surface waters from point sources.	National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges from Construction Activities
	Regulate surface water discharges associated with industrial facilities.	NPDES Industrial Storm Water Permit
New Mexico Water Quality Act, New Mexico Statutes Annotated (NMSA) 1978, §§74-6-1 et seq.	Prevent groundwater pollution, which could result from discharges of effluent or leachate, and to abate any groundwater pollution that occurs at permitted facilities such as mills and mines.	Groundwater Discharge Permit
Federal Safe Drinking Water Act, 40 CFR Parts 144 and 147; New Mexico Ground and Surface Water Protection, New Mexico Administrative Code (NMAC) Part 20.6.2, 2005	Allow underground injection of water; Ensure potable aquifers are not adversely affected by injection of water.	Underground Injection Control Permit
Underground Water, NMSA 1978, §§72-12-1 et seq.	Regulate groundwater use, water rights.	Permit to Appropriate the Underground Waters of the State of New Mexico
Endangered Species Act (ESA) of 1973, as amended (P.L. 93-205)	Comprehensive program for the conservation of threatened and endangered plant and animal species and the habitats in which they are found.	Informal or formal consultation under Section 7; Coordination under Section 9

Table 1-1 Major Federal and State Law, Regulations, and Applicable Permits

Regulation	Brief Description	Applicable Permit or Action
Migratory Bird Treaty Act (MBTA) of 1918, as amended; Bald and Golden Eagle Protection Act of 1940	Protection of birds that live, reproduce or migrate within or across international borders.	Determine compliance through internal review or external review with the U.S. Fish and Wildlife Service (USFWS)
Clean Air Act (CAA); delegated to the State of New Mexico under Air Quality Control Act, NMSA 1978, §§74-2-1 through 74-2-17	Ensure that air pollution sources meet applicable regulations and do not exceed ambient concentration standards for air pollutants.	Air Quality Permit
National Historic Preservation Act (NHPA) (36 CFR Part 800); New Mexico Cultural Properties Act, NMSA 1978, §§18-6-1 through 18-6-17	Review and compliance activities related to cultural resources.	Permits to conduct investigations
Federal Cave Resources Protection Act of 1988, 16 USC 4301 – 4309	Secure, protect, and preserve significant caves on federal lands by identifying their location, regulating their use, and prohibiting destructive acts. Cave locations are to be kept confidential.	Permits for collection and removal of cave resources
Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act (RCRA), 42 USC 6901 et seq. delegated to the state and implemented under New Mexico Hazardous Waste Act	Regulation of hazardous waste storage, treatment, and disposal.	Hazardous Waste Permit
NMSA 1978 Sections 19-1-1 and 19-7-57	Administration and management of all easements and ROWs to use state trust lands for such purposes as installation and maintenance of pipelines, power lines, and access roads.	Access Permit
NMAC Part 14.5.2	Permit to construct buildings from New Mexico Construction Industries Division	General Construction Permit

1.5 Public Participation and Issues

1.5.1 Public Participation

1.5.1.1 Scoping

The BLM initiated the NEPA process for the HB In-Situ Solution Mine Project by preparing an environmental assessment (EA) in 2008. Two public scoping meetings were held on September 16, 2008, to receive public input and comments on the proposed project. During development of the EA and prior to publication, the BLM determined that the preparation of an EIS would be required for the proposed project.

The Notice of Intent (NOI) to prepare an EIS for the HB In-Situ Solution Mine Project was published in the *Federal Register* on January 12, 2010. On the same day, the BLM published the first project Bulletin, which was mailed to 146 interested parties including federal, state, and local agencies and governments. A public service announcement was prepared and submitted to KSVP Radio and the Carlsbad Community Television station for broadcasting. The BLM issued a press release announcing the intent to prepare an EIS and information about the upcoming public scoping meetings. Display advertisements were placed in the Artesia Daily Press, Hobbs News-Sun, and Carlsbad Current-Argus, to inform the public of the scoping meeting dates, times, and locations.

Two public scoping meetings, starting at 1:00 p.m. and 6:00 p.m. on January 26, 2010, were conducted in a semi-open house format, beginning with a formal presentation to the public to ensure that meeting attendees were informed about the project. The presentation was followed by an informal open house to allow meeting attendees to ask questions. BLM representatives staffed information stations on relevant resources and programs (e.g., biology, oil and gas, mining, realty, cultural) to receive public input and answer questions. Display boards showing the NEPA process and maps of the proposed project were provided to facilitate conversation. The BLM's Bulletin, which provided information about the project, the schedule, and the scoping process, was available as a handout to meeting attendees. A total of 35 members of the public attended the scoping meetings.

Verbal comments were noted by BLM representatives, and attendees were encouraged to submit their comments in writing. Comment forms were available for the public to complete and submit to the BLM at the meeting, or for mailing to the BLM at a later date. The BLM received a total of 17 comment submittals (e.g., letter, comment form, verbal comments) containing 133 individual comments during the 30-day public scoping period. Following the close of the public scoping period, comments were compiled and analyzed to identify issues and concerns.

More details on the public scoping process, meetings, and the comments submitted can be found in the "HB In-Situ Solution Mine EIS Scoping Summary Report," dated March 2010, posted to the project website hosted by the BLM, http://www.nm.blm.gov/cfo/HBIS/.

1.5.2 Issues

The preliminary issues of concern identified by BLM personnel, other agencies, and in meetings with individuals and user groups before completion of public scoping related to the potential effects of the proposed solution mining project on the ability to extract oil and gas resources, increased land subsidence, surface water and groundwater supplies, air quality, the stability of underground mine workings, regional socioeconomics, migratory birds, rangeland resources, access to recreation, and cultural resources. Similar concerns were expressed during the formal scoping period for this EIS. A majority of the comments received during scoping were related to the potential impacts associated with solution mining processes, potential impacts to groundwater, the potential for subsidence, and potential impacts to oil and gas exploration and operations. The number of comments by category is provided in **Table 1-2**.

Table 1-2 Comments Received by Category

Category Name	# of Comments
Alternatives	5
Biological Resources	12
Cumulative Impacts	2

Table 1-2 Comments Received by Category

Category Name	# of Comments
Geology	6
Health/Safety	3
Land Ownership/Adjustment	1
Leasing	3
Livestock Grazing/Range Management	3
Mining	26
Mitigation Measures	5
Monitoring	3
NEPA Process	8
Noise	1
Oil and Gas	28
Out of Scope	2
Project Description	21
Public Involvement	2
Reclamation	2
Requests for Information	1
RMP Consistency	1
Socioeconomics	2
Subsidence	19
Surface Disturbance	2
Threatened and Endangered Species	1
Vegetation/Botany	1
Water Resources	40
Wildlife	5
Total	**205**

Many scoping comments identified information that should be included in the description of the affected environment (Chapter 3.0) or effects that should be analyzed in the environmental consequences sections (Chapter 4.0). Examples of scoping comments that are addressed in either Chapter 3.0 or Chapter 4.0 of this EIS include the following:

- Biological resources—describe vegetation types, wildlife habitat, and special status species; evaporation ponds may be toxic to birds; drawdown of the shallow aquifer may affect karst features, fauna in caves, and forage; concerns for effects of leaks in surface pipelines on wildlife; effect of land subsidence and noise on wildlife.
- Geology and subsidence—characterize geologic and hydrologic conditions; effects of well drilling on karst features; potential for increased subsidence due to collapse of pillars and roof during solution mining and its effect on hydrology, oil and gas operations, and brine well collapse.

- Livestock grazing—potential effect of groundwater drawdown on water supplies used for livestock and forage production; existence of large diameter surface pipes would alter travel routes by livestock and wildlife.
- Mining—describe effect of solution mining on the ability to develop oil and gas resources; potential for pillar collapse and rubblization to affect flood pool extent; potential effect of salt and other contaminants on nearby ranch headquarters and rangeland.
- Mitigation and monitoring—establish standardized drilling process to follow regulatory requirements; monitor for leaks and mitigate vegetation damaged by salt contamination; establish ramps over pipelines to facilitate wildlife movement; monitor extent of brine in flood pools; establish mitigation measures to exclude birds from evaporation ponds and monitor success.
- Oil and gas operations—concern that solution mining would interfere with the ability of oil and gas lessees to develop their resources in the vicinity of the proposed project; potential for brine in flood pools to corrode fluid mineral well casings; concern for inadequate plug and abandon techniques of old oil wells that may be affected by the brine within the flood pools; concern that pillars around well casings in the flood pools may fail; allow for concurrent development of potash and fluid minerals.
- Water resources—describe pump tests completed; prepare aquifer modeling to predict drawdown and groundwater movement; effect of water pumping on flows in the Pecos River; drawdown of shallow aquifer may eliminate water in caves or reduce livestock water supplies; describe extent and quantity of the Rustler Formation; evaluate impacts of using alternative water supplies such as water from the Caprock; identify water rights available for project use and whether new water rights are needed; evaluate the effect of pumping on water supply; potential impact of subsidence on hydrology; impact of pumping on water quality; verify that the proposed water sources are adequate for the proposed project; describe the water requirements for the project.

The public comments recommended two possible EIS alternatives that should be considered in addition to the Intrepid's proposed HB In-Situ Solution Mine Project. The options recommended consideration of other water sources to supply brine for the flood pools and increased or concurrent recovery of oil and gas resources.

1.5.2.1 Draft EIS

The Notice of Availability (NOA) for the Draft EIS was published in the *Federal Register* on April 15, 2011. This began the 60-day period for public review and comment of the Draft EIS. Prior to publication of the NOA, The BLM mailed the second project Bulletin to 111 people who indicated that they wanted to be on the mailing list. The BLM mailed hard copies of the Draft EIS to nine people or agencies and 62 electronic copies on CD, based on requests and agency policy. E-mail notification of the NOA and the availability of the Draft EIS for downloading from the project website were sent to 55 people who provided addresses.

Two public meetings were held from 3:00 p.m. to 7:00 p.m., one each in Carlsbad (May 10, 2011) and Hobbs (May 11, 2011), New Mexico. The meetings were publicized through the project website, public service announcements to local radio and television stations, and through display advertisements in Artesia Daily Press, Hobbs News-Sun, and Carlsbad Current-Argus. The meetings began with a formal presentation to the public to ensure that meeting attendees were informed about the project and the findings in the Draft EIS. The presentation was followed by an informal open house to allow meeting attendees to ask questions and submit comments. BLM representatives staffed information stations with display boards showing the alternatives analyzed in detail, some of the key findings from the impact analysis, and information on the NEPA process. Sixty members of the public attended the Carlsbad meeting and 18 people attended the Hobbs meeting.

During the public comment period, The BLM met with representatives from local governments and state and federal agencies to answer questions and explain the findings of the Draft EIS. In response to a request from one agency, The BLM extended the public comment period by two weeks, closing on June 23, 2011 instead of June 13 as originally scheduled.

The BLM received 27 distinct comment letters and 139 form letters from which 217 unique comments were categorized. The comments and responses are provided in **Appendix D** where they are grouped by category.

1.5.3 Consultation and Coordination

On February 1, 2010, the BLM-Carlsbad Field Office sent letters to the following pueblos and tribes notifying them of the proposed HB In-Situ Solution Mine project:

- Apache Tribe of Oklahoma
- Comanche Indian Tribe
- Hopi Tribe
- Kiowa Tribe of Oklahoma
- Mescalero Apache Tribe
- Pueblo of Isleta
- Ysleta del Sur Pueblo

To date, the BLM received responses from the Pueblo of Isleta and the Ysleta del Sur Pueblo. Both Pueblos stated that the project will not impact either Pueblos' religious or cultural sites; however, should discoveries be found during project construction, notification of findings would be appreciated.

On January 27, 2009, prior to initiation of the EIS, the BLM-Carlsbad sent letters to the same tribes listed above to inform them of plans to treat some archaeological sites that are located where the evaporation ponds are planned to be constructed. Responses to these letters were received from the Hopi Tribe and the Pueblo of Isleta. The Hopi Tribe responded that if any prehistoric human remains are discovered during project construction, they would like to be notified prior to excavation and would like to receive copies of reports for their review and comment. The Pueblo of Isleta requested that they be informed of any discoveries found during construction, and would like to receive copies of all environmental documents.

A cooperating agency is typically invited to participate in NEPA projects because it has "special expertise," as defined in CEQ's NEPA regulations at 40 CFR 1508.26. On December 21, 2010, the BLM mailed letters of invitation for cooperating agency status to 42 tribes, pueblos, and federal, state, and local government agencies. Any of these groups that respond will be sent a memorandum of understanding that outlines the responsibilities of the lead agency (BLM) and the cooperating agency. To date, five local governments, two state agencies, and one federal agency have requested cooperating agency status, all of which have signed agreements.

1.6 Organization of the Document

Chapter 1.0 of the EIS provides an introduction and general overview of the proposed project. In addition, this chapter describes the purpose of and need for the proposed project; the decisions to be made; conformance of the proposed project to existing BLM policies, plans, and programs; relevant laws, regulations, and permits that apply to the proposed project; and a summary of outreach activities.

Chapter 2.0 provides a summary of the EIS alternatives; a summary of the alternative eliminated from detailed analysis and the reasons for elimination; detailed descriptions of the alternatives analyzed in the

EIS; a summary of applicant-committed environmental protection measures and BLM-required measures; and a comparison of impacts under each alternative.

Chapter 3.0 describes the existing natural and human environment within the proposed project area, focusing on the conditions that may be affected by the proposed project.

Chapter 4.0 describes the potential direct and indirect impacts to the natural and human environment that would result from the implementation of the Proposed Action and alternatives. It also recommends mitigation measures that would reduce significant impacts. This chapter also discusses the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and irreversible and irretrievable commitment of resources.

Chapter 5.0 describes the cumulative impacts to the natural and human environment that would result from the implementation of the Proposed Action and alternatives, in combination with the impacts contributed by other past, present, and reasonably foreseeable future actions

Chapter 6.0 provides a summary of the public participation and scoping process used to solicit comments on the Proposed Action and identify issues or concerns; a summary of consultation and coordination undertaken to prepare the EIS; a list of federal, state, and local agencies, tribes, pueblos, and private organizations and companies that were contacted during the preparation of the EIS; agencies, organizations, and persons to whom copies of the EIS were sent; and the list of BLM and consultant team members that developed the EIS.

Following Chapter 6.0 is the list of references cited in the EIS, a glossary of terms the readers can use to obtain definitions for scientific or technical terms, and an index of key terms and information presented in the EIS.

Appendices included in the EIS provide supplemental detailed information used to support statements or findings documented in the EIS. **Appendix A** includes the full text of the 1986 Order, a state order that governs oil and gas development in the SPA, and the most recent interim New Mexico BLM guidance for management of the SPA. **Appendix B** includes descriptions of the existing potash lease stipulations and environmental protection measures that may be required by the BLM for construction and maintenance operations in the SPA. **Appendix C** lists the type, location, and status of ROWs within the project area boundaries. **Appendix D** includes the comments on the Draft EIS and the BLM responses to comments.

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2.0 Proposed Action and Alternatives

2.1 Formulation of Alternatives

This chapter describes the alternatives considered in this EIS. These alternatives were developed in response to issues and concerns from public comments submitted during the public scoping period and interaction between resource specialists.

In addition to the No Action Alternative, the proponent's Proposed Action and two other action alternatives are analyzed in detail. The Record of Decision (ROD) may include individual elements from any of these alternatives.

The BLM also considered alternatives raised during the scoping process that are not carried forward for detailed analysis. These alternatives, together with the reasons why they were not included for detailed analysis, are described in Section 2.3.

This chapter concludes with a summary of the environmental effects of the Proposed Action and the other alternatives that are analyzed in the EIS.

2.2 Summary of Alternatives

A brief summary of the alternatives analyzed in detail is included in this section.

2.2.1 No Action Alternative

The No Action Alternative would deny the approval of the proposed project and would not modify the existing potash leases. Current land and resource uses would continue under current conditions in the project area.

2.2.2 Alternative A—Proposed Action

The Proposed Action would include approval of Intrepid's HB In-Situ Solution Mine Operation and Closure Plan, granting new ROWs, approval of permits to drill new water supply, injection, extraction, and monitoring wells, and approval of required lease modifications. Following is a brief summary of Intrepid's proposed operations, projected to function for 28 years. More detail is included in Section 2.4.2.

- Pumping and conditioning of groundwater from seven Rustler Formation wells to form an injectate solution.
- Transport of the injectate through a surface piping system and injection of the solution through six wells into the lower portions of four separate former underground mine workings.
- Extraction of the resulting pregnant brine from the underground mine workings through five extraction wells.
- Pumping the brine through aboveground pipelines to evaporation ponds where the potassium and sodium salts (KCl and NaCl, respectively) would be precipitated.
- Harvest of precipitated potash and salt from the evaporation ponds and transport to a new flotation mill (HB Mill).

- Refinement of ore to marketable potash product at the new HB Mill and the existing Intrepid North Plant. Recycling of NaCl tailings to condition the injection source groundwater to be used for injectate.
- At the completion of the project, all project components and all disturbed areas would be reclaimed and infrastructure would be decommissioned.

2.2.3 Alternative B—Supplemental Water Sources

This alternative would include approval of Intrepid's mine operation and closure plan, granting new ROWs, approval of required lease modifications, and approval of permits to drill new water supply, injection, extraction, and monitoring wells. Additional water sources from Intrepid's Caprock wells east of the project area would be used to supplement the saline water whenever the Rustler water supply is inadequate to meet the optimum filling rate of the flood pools. Intrepid's existing pipelines from the Caprock wells would be improved. Fewer Rustler wells and pipelines would be developed, but all of the other facilities and process plans would be the same as the Proposed Action.

2.2.4 Alternative C—Buried Pipelines

This alternative would approve Intrepid's HB In-Situ Solution Mine Operation and Closure Plan, grant ROWs with modifications designed to limit surface facilities, approve permits for new water supply, injection, extraction, and monitoring wells, and approve lease modifications. Intrepid's proposal would be modified to bury all pipelines. The layout of the pipeline system would be the same as that described for Alternative A, Proposed Action.

2.2.5 Alternative D—Preferred Alternative

According to CEQ's NEPA regulations at 40 CFR Section 1502.14(e), the agency's preferred alternative should be identified in the Final EIS. This alternative must fulfill the BLM's mission and responsibilities, while giving consideration to economic, environmental, technical, and other factors. This alternative is designed to minimize the impact to wildlife from habitat fragmentation and to allow better emergency and grazing access than under the Proposed Action. It would also mitigate conflicts with OHV users. The BLM, as the decision-maker, selected aspects of Alternatives A, B, and C to develop the Preferred Alternative. This alternative includes approval of Intrepid's revised HB In-Situ Solution Mine Operation and Closure Plan, granting new ROWs, approval of lease modifications to remove 12,867 acres from the 96,000-acre conventional mining lease limit per state, and approval of permits to drill new water supply, injection, extraction, and monitoring wells. The overall footprint of the evaporation ponds would increase by 62 acres. There would be minor changes to the layout of the pipelines in the project area to avoid karst features and improve the efficiency of layouts for a variety of reasons. Approximately 68 percent of the pipeline bundles would be buried. Within the project area, four Rustler wells would be developed and additional water sources from Intrepid's Caprock wells east of the project area would be used to supplement the required water quantity whenever the Rustler water supply is inadequate to meet the optimum filling rate of the flood pools. A new pipeline from the Caprock wells would be installed along an alignment designed to avoid sand dune lizard habitat. All of the process plans would be the same as the Proposed Action.

2.3 Alternatives Considered but Eliminated from Detailed Analysis

2.3.1 Conventional Underground Mining of Remaining Reserves

This alternative would involve conventional, physical mining of the remaining potash reserves in the proposed flood zones, without any in-situ flooding. Although areas of second mining still contain approximately 30 percent of the original ore in place, they can no longer be safely accessed because convergence (settling of the mine ceiling) has made these portions of the mine impassable. To extract the remaining ore, workers and equipment would need to physically access the pillars, remove them, and transport the ore to the surface. The existing HB shafts and hoists are not operational and the ventilation and utility systems would have to be restored to comply with Occupational Safety and Health Administration (OSHA) and Mine Safety and Health Administration (MSHA) operational conditions, which would not be feasible for the second mined areas.

This alternative has been eliminated from detailed analysis because it does not meet the purpose and need of allowing technically viable development that would comply with existing mine and safety regulations. It would not be safe to extract the potash from the inactive workings (HB Crescent, HB North, HB South, and HB Eddy) through conventional mining methods.

2.3.2 Solution Mining of Additional Potash-bearing Formations within the Secretary's Potash Area

This alternative would involve the injection of saline brine to the SPA to leach the in-place water-soluble minerals from unmined formations. This in-situ solution mining would be more extensive than the Proposed Action. This alternative differs from the Proposed Action in that hot water is typically used as a solvent, which is injected into productive formations through cased boreholes. In this process, the brine flows through the target formation, and is extracted through another borehole, to be processed to remove the potash. Existing mine workings are not required for this process.

With current technology, the potash ore suitable for solution mining is located in the first ore zone within the SPA where the ore is high in potassium, located in a continuous ore body, and low in undesirable minerals such as sulfur and magnesium. Solution mining of potash with high levels of sulfate and magnesium chloride would require a much larger area for evaporation ponds because the concentration of potassium chloride in the injectate would be approximately half that of the levels in the first ore zone currently proposed for solution mining under the Proposed Action. Additional land also would be required for separating and storing the undesirable minerals that must be transported off-site for disposal. While potassium magnesium sulfate (langbeinite) can be processed into a saleable product, this process is not part of Intrepid's future plans.

Consideration of the elevations of other potash-bearing formations is another key factor in determining the location of ore that is suitable for solution mining. Not all potash-bearing formations could safely be produced through solution mining because targeted areas must be located where active mines and operating oil or gas wells would not be flooded.

The 1986 Order provides policy and guidance for concurrent development of potash and oil and gas (see **Appendix A** for copy of the full 1986 Order). A condition to granting potash leases listed in the 1986 Order is that:

> All potash permits and leases hereafter issued or existing potash leases hereafter renewed for Federal lands within the designated Potash Area, shall be subject to a requirement either to be included in the lease or permit or imposed as a stipulation, to the effect that no mining or exploration operations shall be conducted that, in the opinion of the authorized officer, will constitute a hazard to oil or gas production, or that will unreasonably interfere with orderly development and production under any oil or gas lease issued for the same lands.

Any new project would be evaluated on a case-by-case basis in order to evaluate project-specific resource concerns and to ensure compliance with the 1986 Order. Solution mining also would be limited to leases held by the operator.

This alternative has been eliminated from detailed analysis for the following reasons.

- The proposal would not meet the purpose and need of allowing technically viable potash development. Current information shows that most of the SPA does not contain the contiguous, high quality potash ore in sufficient quantity needed for viable solution mining.
- Solution mining of all potash-bearing formations within the SPA would not meet the purpose and need of complying with the 1986 Order. There are many areas within the SPA that cannot be flooded due to safety concerns. The elevation of the injectate flood pools must be controlled to avoid flooding active mines and operating oil or gas wells, otherwise they pose a hazard to production and would unreasonably interfere with oil and gas development. Giving priority to potash mining over fluid minerals in the project area would not be in compliance with the 1986 Order or BLM policy, which requires concurrent development.

2.3.3 Smaller Flood Area

This alternative would use smaller flood zones and lower flood elevations in each of the four targeted mine workings. Because less water would be required, lower pumping rates would be needed to fill the flood pools but the same infrastructure (pipelines, roads, mill) would be needed as described under the Proposed Action. Lower quantities of potassium-bearing salts would be processed, resulting in reduced potash production, lower revenues, and less efficient resource recovery.

This alternative has been eliminated from detailed analysis because it would not meet the purpose and need for the project, which describes the BLM's responsibility to support the orderly and efficient development of leasable minerals in accordance with applicable federal law, including Title 30, Chapter 2, Section 21a, which requires wise and efficient use of mineral resources. In addition, this alternative would not meet the requirement for ultimate maximum recovery of mineral resources under 43 CFR 3594.1. Maximum recovery of potash would not be achieved, resulting in a waste of the resource, while the same amount of surface disturbance for infrastructure would be needed. Undue waste of mineral resources also is prohibited by the FLPMA and MLA.

2.3.4 Larger Flood Area

This alternative would involve the in-situ extraction of potash in the same targeted mine workings as those described under the Proposed Action but using a larger flood pool. Flood control in the mine workings is based on the geologic structure and elevation of the mine features, so the larger flood pool would be accomplished by setting a higher maximum elevation of the injected brine than that selected for the Proposed Action.

Setting higher flood elevations in HB Crescent and HB North mines would pose unacceptable risks to the safety of underground personnel in Intrepid's operating West Mine, a conventional mine that has underground connections due to previously established drifts. If higher flood elevations were set in HB South and HB Eddy mines, the flood pool may reach operating oil wells in the Barber Field through existing underground connections. Flooding the HB2 East mine would not be safe because it has underground connections to Intrepid's West Mine.

This alternative has been eliminated from detailed analysis because it does not meet the purpose and need of complying with existing mine and safety regulations and it would violate the 1986 Order. A larger flood zone in the four targeted mine workings would threaten the safety of workers in Intrepid's West Mine. It might also adversely affect operating oil wells in the Barber Field, constituting a hazard to oil or gas production in violation of the 1986 Order.

2.3.5 Allow Expansion of Oil and Gas Development in the Project Area

Public comments submitted during the scoping period requested consideration of an EIS alternative that gives increased access to development of oil and gas reserves within the project area. This alternative would remove the suspension of oil and gas leases to allow more drilling and production in the project area.

The 1986 Secretary's Potash Order provides policy and guidance for concurrent development of oil and gas and potash (see **Appendix A** for copy of the full 1986 Order). A condition to the granting of oil and gas leases listed in the 1986 Order includes two relevant requirements:

1. Drilling cannot interfere with "the mining and recovery of potash deposits," a situation to be determined by the BLM Authorized Officer.
2. Oil and gas wells cannot be drilled at a location that would "constitute a hazard to or unduly interfere with mining operations being conducted for the extraction of potash deposits."

The 1986 Order further states that the USDI should "deny approval of most applications for permits to drill oil and gas test wells from surface locations within the potash enclaves" with the following two exceptions that are up to the discretion of the BLM Authorized Officer.

- Drilling shall be allowed from barren areas within the potash enclaves when "such operations will not adversely affect active or planned mining operations in the immediate vicinity of the proposed drillsite."
- Drilling shall be allowed from a drilling island located where there are no barren areas within the enclave or where the objective oil and gas formation beneath the lease cannot be reached by a well drilled from a permitted location within the barren area or by a well directionally drilled from a surface location outside the potash enclave.

Many of the suspended oil and gas leases lie beneath open potash mine workings. Many of these potash workings, even long inactive ones, connect directly to workings that are being actively mined. Drilling wells though open mine workings would potentially allow for the flow of oil, water, and gases into the active mines and pose a health and safety hazard to mine workers.

This alternative has been eliminated from detailed analysis because it does not meet the purpose and need of complying with the 1986 Order. Giving priority to fluid minerals over potash mining in the project area would not be in compliance with the 1986 Order or BLM policy, which requires concurrent development. In addition, drilling through open mine working would be in violation of the part of the 1986 Order specifying that oil and gas cannot be drilled in a location that would pose a safety hazard to potash mining.

2.3.6 Use Capitan Aquifer as Water Source

One comment received during the comment period for the Draft EIS recommended that brine from the Capitan Aquifer be considered as a potential source of water for the solution mine project to provide an alternative to extracting water from either the Rustler Formation or the Caprock Aquifer. In response to this request, the BLM considered whether this would be a viable option to be analyzed in the EIS. A summary of those findings is provided below.

The Capitan Aquifer lies beneath the HB In-Situ Solution Mine project area, mainly below Clayton Basin. The Capitan Aquifer is found within the Permian (Guadalupian) Capitan and Goat Seep limestones, as well as in the forereef and backreef facies that border the main limestone reef structure. In the project area, the Capitan Aquifer forms a band of water-bearing limestone between the Pecos River and the Eddy County/Lea County line. The Capitan Aquifer in and near the project area is 10 to 14 miles wide, lies at a depth of 1,500 to 2,000 feet below ground surface, and is about 1,500 to 2,000 feet thick (Hiss 1976, 1975).

Before the formation of the Pecos River, the Capitan Aquifer was an integrated flow system that was recharged in the Guadalupe Mountains with groundwater flowing eastward and discharging near Hobbs, New Mexico. With the formation of the Pecos River in Pleistocene times, groundwater flow from the Guadalupe Mountains was intercepted by the Pecos River, causing groundwater flowing into the Capitan Aquifer east of the Pecos River in Eddy County to be reduced. There is a series of low permeability submarine canyons that bisect the reef and limit connectivity to the eastern and southern parts of the aquifer. Today, the Capitan Aquifer in northern Eddy County between the Pecos River and the Lea County line is confined and artesian. With little source of recharge and a low permeability submarine channel along the Lea County line, the groundwater flow is stagnant in northern Eddy County east of the Pecos River.

Aquifer tests report by Mercer (1983) and Richey and Wells (1984) show that the range in hydraulic conductivity for the Capitan Aquifer in northern Eddy County east of the Pecos River is between 1 and 25 feet per day, with most test values falling between 2.4 and 16 feet per day. The estimated average hydraulic conductivity is 5 feet per day. Test wells yielded on average less than 50 gpm (Hiss 1976). Overall, the permeability of the Capitan Aquifer in the project area is low, suggesting low well yields for water supply. This contrasts with the eastern side of the aquifer where higher yields have been documented in locations such as the Jal well field in Lea County.

There are 30 salt water injection wells injecting into or near the Capitan Aquifer in the vicinity of the project area. These wells may inject a variety of contaminants, including heavy metals. The effect of these wells on the water quality in the aquifer is unknown and would need to be analyzed before the water could be used for industrial projects such as the in-situ solution mine. The lack of information on the effects of the injection wells creates uncertainty as to the viability of the local Capitan water quality for long term usage. Acquiring the information needed to evaluate the Captain Aquifer for the HB In-Situ Solution Mine Project would be a time-consuming and expensive undertaking with a low probability success, given the existing data.

In summary, existing data suggest that it is unlikely that the Capitan Aquifer would provide an adequate supply the water to the HB In-Situ Solution Mine Project. Wells attempting to use the Capitan Aquifer water in the project area would likely be very deep with low yields. In addition, there are uncertainties regarding water quality due to the possible introduction of contaminants from the salt water injection wells. Intrepid does not have water rights in the Capitan and did not propose using this aquifer to supply project water. For these reasons, this alternative water source is unlikely to be suitable and was eliminated from detailed analysis.

2.4 Alternatives Analyzed in Detail

2.4.1 No Action

The No Action Alternative must be addressed under provisions of NEPA and serves as a basis for comparison of environmental impacts among alternatives. Under the No Action Alternative, the BLM would deny Intrepid's application for ROWs, mine operation and closure plans, and special use permits for in-situ solution mining. As a result, the proposed new surface pipelines, evaporation ponds, access roads, and new HB Mill would not be constructed, leaving the current uses of the land in the project area unchanged. The potential impacts to the human environment under the Proposed Action would not occur. Existing operations at Intrepid's West and East mines would continue under existing authorizations until the leased potash reserves are depleted. The No Action Alternative does not mean that there would be no impacts to the lands in the project area. Current mining operations and maintenance activities would continue.

There would be no change in Intrepid's federal potash lease acreage, currently 22,189 acres within the project area and 81,926 acres in the SPA. The BLM would consider lease modifications recently proposed by Intrepid, up to the maximum of 96,000 acres per state, in compliance with 43 CFR §3503.37, as amended.

Management of mineral leasing and development would continue to be governed by the federal 1986 Secretary's Potash Order and IM NM-2011-003, Interim Processing Guidelines, Oil and Gas Applications for Permit to Drill (APDs) within the "Secretary's Designated Potash Area," Carlsbad Field Office. Instruction Memorandum (IM) NM-2011-003 will remain in place until new standards for defining the potash enclave are approved. Mineral leasing and development also are managed under the State of New Mexico's Order No. R-111-P, Application of the Oil Conservation Division Upon Its Own Motion to Revise Order R-111, As Amended, Pertaining to the Potash Areas of Eddy and Lea Counties, New Mexico.

2.4.2 Alternative A—Proposed Action

The Proposed Action consists of constructing and operating an in-situ solution mining project in existing deep mine workings to recover and process potassium chloride ore from pillars and limited adjacent areas of the back, floor, and ribs. These mine workings are not in operation and the ore is currently not technically recoverable through conventional mining techniques. The area proposed for potash extraction occurs within existing Intrepid leases. Intrepid's existing leases affected by solution mining would be changed from conventional to solution mining leases and the acreage would not be counted against the 96,000-acre cap for each lessee in a state (43 CFR §3503.37, as amended).

The in-situ solution mining process would inject NaCl-saturated water into the deep mine workings. After allowing time for chemical reactions to occur, a mineral-rich solution with a high concentration of dissolved KCl derived from the mine workings would be pumped to the surface and transported to evaporation ponds. Once the mineral-rich solution evaporates in the ponds, the potassium-bearing and sodium-bearing salts precipitated (left behind in solid form) would be harvested from the ponds and transported for refinement in a newly constructed mill.

The project area consists of 38,453 acres, of which the majority is public land managed by the BLM. **Table 2-1** lists the acreage of each land status in the project area.

Table 2-1 Land Status in the Project Area

Owner/Manager	Acres
BLM	31,439
State of New Mexico	4,954
Private	2,060
Total	**38,453**

The project area encompasses 24,266 acres of federal potash leases. Four inactive workings totaling 10,930 acres would be partially flooded. The surface area of the flood pools is estimated to be 4,354 acres when full. For construction, it is estimated that a maximum of 274 workers would be employed for at least 3 months, and up to 263 workers would be employed during the second year of construction. During the operations phase, Intrepid would employ 36 workers for the 28-year life of the project, in addition to its current work force of over 600 employees.

Intrepid estimates total new investment of $120 million to $130 million for construction costs under the Proposed Action over a period of approximately 18 months. During the production phase, annual production costs of between $11.4 million and $13.9 million are estimated. At full production, it is estimated that 175,000 to 185,000 tons of potash would be generated annually, for a total yield of 5 million tons over 28 years.

2.4.2.1 Components of Proposed Action

Groundwater Sources

A total of seven wells would be developed in the Rustler Formation to a depth of up to 500 feet to supply saline groundwater. The proposed wells, called Rustler Wells on **Figure 2-1**, are located within Sections 1 and 2 (5 wells shown, 4 would be drilled) of Township 21 South (T21S), Range 29 East (R29E), to the north and east of the proposed evaporation ponds, and within Section 4 of T20S, R30E (3 wells shown close together). Because lead contamination has been documented in the wells in Section 4 of T20S, R30E, the water coming from these wells must be treated to remove the lead before combining with the other Rustler well water to prepare for injection into the flood pools.

One of the wells in Section 2 has already been drilled as part of the initial evaluation during the preliminary engineering investigation for the project. Eight wells are displayed on the map because there are two optional locations in the area near the evaporation ponds. The decision on the location of which of the two options would be installed is dependent on the observations and yields of the other wells in the Section 2 area.

Each production well would be completed with a 10-foot by 6-foot concrete pad to support surface instrumentation, provide a maintenance surface, and provide for well casing integrity. A pilot/test/instrumentation (PTI) well would be drilled adjacent to each production well on a separate 10-foot by 6-foot concrete pad. The remainder of the 50-foot by 50-foot well pad would be surfaced with caliche, fenced, and surrounded by a berm to provide containment. Each of the Rustler water supply wells would include automated monitoring systems, controls, and backflow preventers to maintain flood level control and protect well integrity.

Fresh water from an established well field in the Caprock regional aquifer in Lea County would be used only for mill processing.

HB Mill

A new mill, called HB Mill on **Figure 2-1**, would be new construction, composed of a new building, flotation mill, filtration plant, clarifiers, and associated facilities. The total footprint of the HB Mill facilities would be approximately 4.5 acres on BLM land in Section 12, T21S, R29E.

Injection and Extraction Well Network

Six injection wells, five extraction wells, and three monitoring/extraction wells would be installed to enable the injection and extraction of brines to and from the former mine workings (see **Figure 2-1**). The injection wells would be sited in locations that would facilitate injection of the brine and gravity flow to the flood pools, generally on the uphill side of the targeted ore zone. The locations of the injection wells were selected to ensure that the brine would fill the lower mine workings up to the maximum flood elevation in the targeted area for the flood pool. Prior to the installation of the injection, extraction and monitoring/extraction wells, a small-diameter PTI well would be installed on the same well pad to determine site-specific subsurface conditions and as instrumentation/monitoring wells.

The extraction wells would be installed at a location suitable to enable the pregnant brine to be extracted from the lower portions of the flood pool. The monitoring/extraction wells located in the east-central part of the project area south of the flood pools would be used to check whether any pregnant brine flows outside and downslope from the flood pool. If monitoring detects underground pregnant brine outside the flood pool, the monitoring wells would be used to extract the brine to a pipeline designed to carry it to the evaporation ponds.

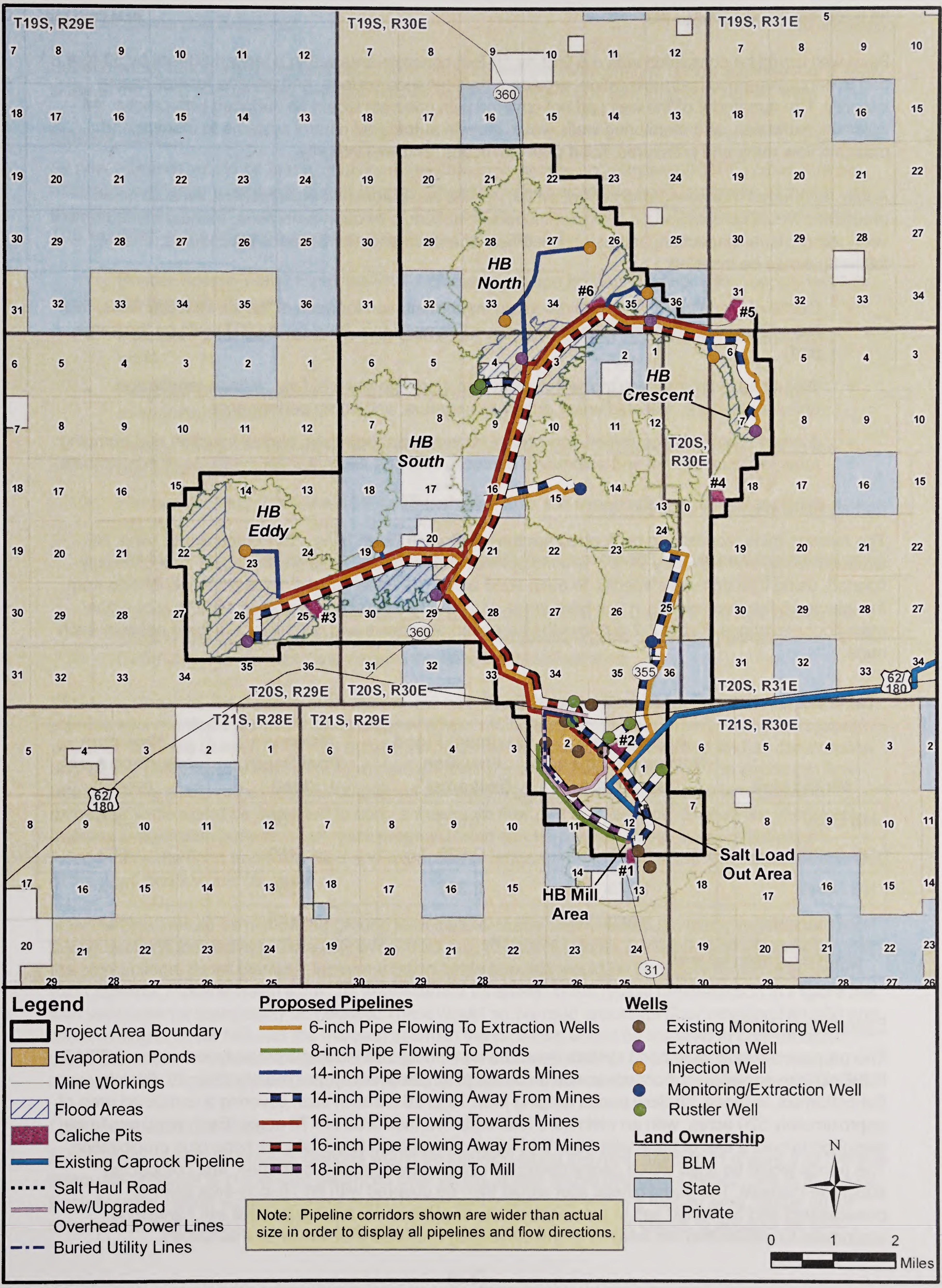

T19S, R29E
T19S, R30E
T19S, R31E
T20S, R29E
T20S, R30E
T20S, R31E
T21S, R28E
T21S, R29E
T21S, R30E
HB North
HB South
HB Crescent
HB Eddy
HB Mill Area
Salt Load Out Area
#1
#2
#3
#4
#5
#6
360
355
62/180
31
Legend
Project Area Boundary
Evaporation Ponds
Mine Workings
Flood Areas
Caliche Pits
Existing Caprock Pipeline
Salt Haul Road
New/Upgraded Overhead Power Lines
Buried Utility Lines
Proposed Pipelines
6-inch Pipe Flowing To Extraction Wells
8-inch Pipe Flowing To Ponds
14-inch Pipe Flowing Towards Mines
14-inch Pipe Flowing Away From Mines
16-inch Pipe Flowing Towards Mines
16-inch Pipe Flowing Away From Mines
18-inch Pipe Flowing To Mill
Wells
Existing Monitoring Well
Extraction Well
Injection Well
Monitoring/Extraction Well
Rustler Well
Land Ownership
BLM
State
Private
N
0
1
2
Miles
Note: Pipeline corridors shown are wider than actual size in order to display all pipelines and flow directions.

Figure 2-1 Facilities to be Constructed under the Proposed Action

Each well would be completed with a 6-foot by 10-foot concrete area within a fenced 50-foot by 50-foot pad to support surface instrumentation, provide a maintenance surface, and provide for well casing integrity. The remainder of the well pad not covered with concrete would be surfaced with caliche. All injection, extraction, and monitoring wells would include automated control systems to monitor and maintain flow rates and pressures, flood pool elevations, and well integrity.

A fully automated monitoring and control system for the wells would be implemented. All automated processes would be checked on a regular inspection schedule through calibration, manual measurement verification, visual inspection, and established field operation and maintenance procedures. The following would be installed:

- Downhole monitoring and data recording instrumentation for each of the six injection wells, five extraction wells, and three monitoring/extraction wells (provided by the PTI wells on the same pad).
- Well-head instruments to monitor such information as pressure, flow, voltage, amperage, annular pressure, selected water quality parameters, and pump performance.
- A centralized data acquisition and control center to manage data, control injection and pumping rates, execute alarms and automated contact trees, and allow manual overrides or adjustments.

Former Mine Workings to be Flooded

The existing mine workings to be flooded are the HB Potash North Mine, HB Potash South Mine, HB Crescent Mine, and HB Eddy Mine. Portions of these four separate mining units would be individually flooded, using injection wells specific to each flood area. The underground pools would be formed from the injected brine that collects in low-lying areas of the mine, contained by a solid mine face or higher mine floor elevations. **Table 2-2** displays the proposed elevations and depths for the flood pools in each mine.

Table 2-2 Flood Pool Elevations and Depths

Mining Unit	Approximate Bottom Elevation (feet amsl[1])	Maximum Flood Elevation (feet amsl[1])	Maximum Pool Depth (feet)	Maximum Surface Area (acres)
HB Eddy	2,575	2,675	100	1,865
HB South	2,375	2,525	150	668
HB North	1,975	2,325	350	1674
HB Crescent	2,050	2,200	150	147

[1] amsl = above mean sea level.

Evaporation Ponds

The proposed evaporation pond system would be constructed on Intrepid's property in Section 2, T21S, R29E. The evaporation pond system would consist of a network of approximately 23 to 26 discrete, flat-bottomed, terraced, shallow ponds ranging from 16 to 26 acres in size, covering a combined area of approximately 520 acres, with an estimated total water surface area of 470 acres. Each pond would be designed to hold 2 feet of brine with 18 to 24 inches of freeboard to contain the brine plus precipitation. The ponds would be lined with a geosynthetic liner placed over graded, screened, and compacted subgrade material. The geosynthetic liner would then be covered with an 18-inch-thick layer of consolidated and hardened salt to provide a structural platform for the mechanical salt harvesting equipment to ensure that the integrity of the underlying synthetic liner would be maintained.

Surface water runoff would be kept out of the ponds by two diversion ditches on the southeast and west sides of the pond system. The diversion ditches would each be 4,000 feet long and 12 feet wide.

Pipeline System

All new pipelines would be black, ultraviolet-resistant high density polyethylene (HDPE) pipes that are extrusion-welded or joined with bolted flanges. These pipelines would be used to convey all fluids associated with the HB In-Situ Solution Mine Project except that coming from the Caprock well fields. The locations of the following pipelines are shown on **Figure 2-1**.

- Rustler Source Water Pipelines—14-inch-diameter pipe from the Rustler water supply wells to the new HB Mill area.
- Injectate Pipelines—14- to 16-inch-diameter pipe from the new HB Mill area to the injection wells.
- Pregnant Brine Pipelines—14- to 16-inch-diameter pipe from the extraction wells to the evaporation ponds.
- Dilution Lines—4- to 6-inch-diameter pipe from the existing Caprock fresh water line to the extraction wells.
- Harvested Slurry Pipelines—14- to 18-inch pipe from the evaporation pond system to the new HB Mill.
- Mill Recycled Make-Up Pipeline—8-inch-diameter pipe from the HB Mill to the evaporation pond slurry pit.
- Caprock Fresh Water Pipeline—Tap into the existing 6-inch line Caprock line that serves the Intrepid West Facility to supply fresh water to the HB Mill. This is an existing pipeline that carries Caprock water from existing wells to the east of the project area.

Wherever possible, the pipeline alignment would be located along existing roads and ROWs. The pipeline alignments would avoid steep slopes. Where multiple pipelines are present, the various pipes would be laid next to each other in a bundle. All pipelines would be pressure tested and all construction and testing procedures would follow standard engineering and industry protocols. The maximum flow rate generally would not exceed 2,000 gallons per minute (gpm). However, the pipelines from the extraction wells would be designed to carry a maximum flow rate of 3,200 gpm to allow for short-term high net evaporation periods when more pregnant brine can be handled in the evaporation ponds. Ideally, once the flood pools are filled and extraction of pregnant brine begins, the flow rates into and out of the flood pools would be equal.

New pipelines would be laid on the ground surface after it has been cleared of woody vegetation, with buried sections located approximately every 0.25 mile to enable wildlife, livestock, and vehicles to cross the obstructions. Small diameter instrumentation cable bundles would be shallowly buried underneath each pipeline. Pipeline burial would be implemented as shown in the typical cross-section in **Figure 2-2**, with variations for topography as needed. There would be six road crossings (four crossing NM 360 and two crossing U.S. 62/180 and the railroad) at which the pipelines would be installed in conduit bored under the roads or routed through an existing concrete channel under U.S. 62/180. Specific design characteristics regarding piping size, flow rates, and pressures are subject to final design modifications.

Other Associated Facilities

A maximum of eight lift/booster stations would be installed along the main pipeline to ensure that there is adequate pressure to pump long distances over varied slopes and to overcome friction loss in the pipes. Each booster station would include a pump house and power pole within a fenced area. Surge tanks may be included at each booster station. All designs would include check valves to account for anti-

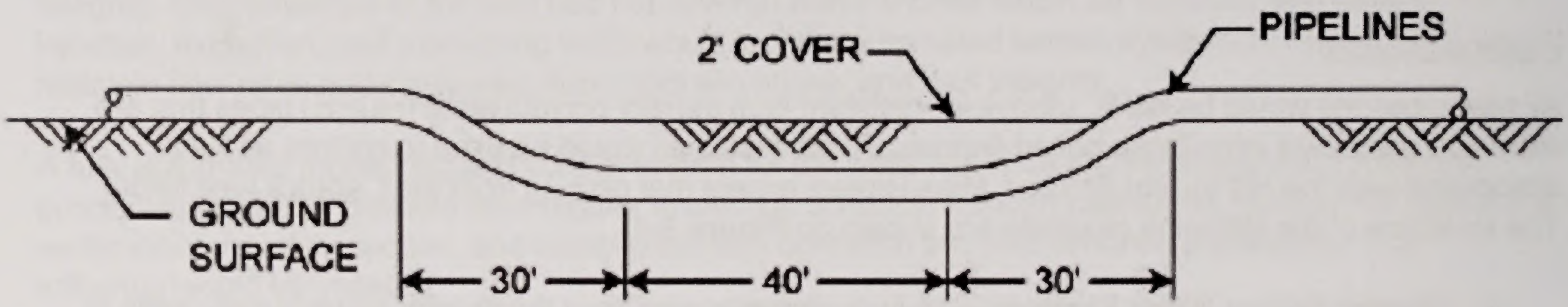


Figure 2-2. Typical Installation of Buried Pipe Section

backflow or siphon conditions and instrumentation to monitor pipeline performance and adjust interdependent flow rates and pressures.

Electric power would be supplied to the Rustler water supply wells, extraction wells, monitoring/extraction wells, and booster stations via overhead power lines, using existing lines and ROWs wherever possible. New power lines would be installed within the pipeline ROWs, with wooden poles spaced approximately 300 feet apart.

New access roads would be constructed along each pipeline within the 50-foot ROW to facilitate access for construction, operation, and maintenance. All roads would be cleared of vegetation and surfaced with gravel or caliche to maintain a 12-foot-wide running surface. To provide enough caliche (up to 93,600 cubic yards), up to six borrow pits would be used (see **Figure 2-1**). Two of these pits (#1 and #6) currently exist, and four new pits are proposed. One pit also would be a source for sand if needed to bed the pipes. All caliche pits would be on land managed by the BLM and would require BLM permits and site-specific approval before excavation can begin.

A road, approximately 2 miles long, from the evaporation ponds to the new HB Mill would be constructed for heavy equipment to haul salt to the ponds from the salt load-out pad adjacent to the existing West Mine Plant tailings pile. This is an existing road that would be widened, graded, and improved. The purpose of the salt haul road is to haul salt from the West Plant tailings area to the evaporation ponds where the salt would be used as protective cover over the pond geosynthetic liner. This haul road would be used for pond construction and as an access road during project operations.

The 50-foot-wide pipeline ROWs would total 38 miles in length. Half the width of the pipeline ROWs (25 feet) would be occupied by pipelines, and roads.

Within Section 2, T21S, R29E, three Xcel Energy overhead power lines with ROWs totaling 3.4 miles, two New Mexico Gas Company underground gas lines (1.8 miles), and one AT&T fiber optic line (0.6 mile) would require relocation prior to construction of the evaporation ponds. These lines would be relocated on Intrepid fee land, as shown on **Figure 2-1**.

2.4.2.2 In-Situ Solution Mining Process

This section describes the steps in the process as they would occur once all components are in place.

Groundwater Pumping and Conditioning of Injectate

Groundwater from the Rustler water supply wells would be pumped using submersible pumps, then transported through 14-inch pipelines from the production wells to the Groundwater Conditioning Unit at the new HB Mill. Rustler water would be pumped at a maximum rate of 2,000 gpm and an average rate of 1,054 gpm. It is anticipated that the maximum pumping rates would occur during the initial filling phase (years 0 to 7) until the former mine workings are filled to the maximum pool elevations. During years 8 to 21, the average pumping rate (1,054 gpm) would be maintained, and during the final phase (years 22 to 28) no pumping from the Rustler wells would occur.

The Rustler groundwater would be conditioned by adding NaCl produced from two sources: the existing West Mine facility tailings and an NaCl brine stream from the new HB Mill. Prior to operation of the new HB Mill and during periods when the new HB Mill does not produce enough NaCl, NaCl would be obtained from the existing West Mine facility. After harvesting from the evaporation ponds begins, the NaCl tailings stream from the new mill would be used to condition the water for injectate. The injectate should be composed of approximately 24 percent NaCl, 1 percent KCl, 0.5 percent magnesium chloride, and 0.4 percent calcium sulfate.

Caprock water would be pumped and transported from Intrepid's Caprock well fields in Lea County for use in mill processing. Approximately 267 gpm would be needed for Phase I and 208 gpm for the remainder of the project.

Filling the Former Mine Workings

The conditioned injectate would be pumped to the six injection wells through pipes ranging from 12 to 16 inches in diameter. The injection wells would supply injectate to the four underground mine workings: HB Potash North, HB Potash South, HB Crescent, and HB Eddy. The maximum combined injection rate for the six injection wells is 2,000 gpm at pressures of up to 160 pounds per square inch (psi). The individual mine units would take from 1 to 70 months to fill, depending on applied pumping rates and flood pool size.

The ore dissolution process works by selectively dissolving and leaching potassium and magnesium chloride salts from the floors, pillar walls, and ceiling of the former underground mines where interconnected KCl is exposed to the injectate solution, producing the pregnant brine. In the ion-exchange process that occurs, sodium ions in the injectate are exchanged for potassium ions, creating the pregnant brine. The sodium ions replace the potassium ions in the pillars and walls to a thickness of up to 18 inches so the area of the pillars and walls in contact with the injectate does not completely dissolve.

The proposed flooding sequence would fill the HB Crescent Mine first followed by the other three underground mine areas. The HB Crescent underground mine workings would contain the smallest flood pool, estimated to be filled in within 1 month at maximum injection rates. This would allow dissolution to occur over the following 5 months and extraction to begin in the second half of the first year of the project. As each mining unit is filled, flow rates, injected volumes, flood pool elevations, and brine quality would be monitored and assessed. The actual timing of filling, dissolution periods, and extraction of pregnant brine depends on a variety of factors and decisions to be made by Intrepid once the project implementation begins.

When all the void spaces are filled to the maximum flood elevation levels, steady state conditions (equal injection and extraction rates) would be maintained until pregnant brine grade reaches a point that further injection is not economically beneficial. At that point, injection would be terminated and only extraction of the pregnant brine would occur.

The length of time to fill, dissolve the potash, extract the pregnant brine, and empty each mine flood pool would vary with the size of the flood pool. In general, there would be a filling period between 2 to 35 months long, depending on the mine. The ore dissolution time would range from 14 to 136 months; the period for equal injection/extraction rates would vary between 12 to 100 months; flood pool emptying time would range from 2 to 35 months long. Many of these activities would be concurrent within the 28-year project life.

Many factors, such as salt dissolution rates, blending requirements for conditioning, net evaporation rate variability, mechanical interruptions, and other operating factors would influence the actual injection and pumping schedules. Site-specific data analysis and process simulations have been used to design the dissolution process, plant capacity, and associated infrastructure, but actual produced brine chemistry would be used to make adjustments to facility operations once the project is underway.

Extracting and Transporting the Pregnant Brine

Once the pregnant brine reaches the optimal concentration of KCl, it would be extracted from the underground workings through a system of five extraction wells. The average combined rate of pumping from the flood pools using the 5 extraction wells would be 1,054 gpm.

The extracted pregnant brine would be transported to the evaporation ponds through the 14- to 16-inch-diameter pipelines. The maximum permitted discharge to the evaporation ponds is 4,608,000 gallons per day (gpd) or 3,200 gpm, which is equal to the maximum pipe design flows. The maximum extraction rate and transport of pregnant brine may occur during short periods of high net evaporation rates when climatic conditions are favorable.

Operation of the Evaporation Ponds

Once the pregnant brine extraction begins, the evaporation ponds would be continually filled using a piping manifold network. Portable pumps and siphons would be used to manage brine solutions within the ponds. Over time, evaporation would concentrate the brine to a point where the NaCl and KCl precipitate out as solids. During the steady state phase of the project (years 8 to 21) after the ponds are filled to maximum design elevations, the rate of flow to the evaporation ponds would equal the brine injection rate and the net evaporation rate.

After sufficient KCl has precipitated, selected ponds would be drained and the precipitated product would be harvested by a mechanical scraper. The solid product would be hauled to a slurry mixing facility within the evaporation pond system, where slurry would be created and pumped to the new HB Mill through a 14- to 18-inch-diameter pipeline. Each pond would be intensively managed and harvested approximately once per year. The magnesium chloride (MgCl) bitterns, a waste product, would be routed to other ponds for further evaporation.

Throughout this process, brine enriched with MgCl mixed with trace amounts of sulfate and other insoluble residuals (bitterns) would be produced as a by-product. The bitterns would be sequentially segregated and pumped into one of the lined ponds within the evaporation pond area, designated specifically for magnesium chloride storage or disposal. The magnesium-enriched brine stream within the evaporation pond system would be transferred using moveable, HDPE pipelines and a trailer-mounted pump. The amount of magnesium-enriched brine generated at full build-out of the evaporation pond facility is estimated to be less than 20 gpm of combined flow. Intrepid plans to treat the bittern by-product stream into a commercial magnesium product as market conditions allow. If treating and selling this product is unsuccessful, the MgCl bitterns may be returned to the underground mine workings.

Processing at the New HB Mill

The ore harvested from the evaporation ponds would be pumped through a 14- to 18-inch pipeline in slurry form to the new HB Mill for further treatment. The mill would operate for 355 days per year. The KCl and NaCl would be separated in the flotation mill using an amine flotation process, then classified and filtered to finally render a refined potash cake with a 4 to 7 percent moisture content. This product would be conveyed to a dryer system at the existing Intrepid Potash North Plant where the product would be prepared for market.

The NaCl byproduct generated in the flotation process would be recycled and piped to the Groundwater Conditioning Unit to be mixed with Rustler groundwater for preparation of the brine injectate. Any excess

NaCl byproduct not needed to condition injectate would be stored on a lined, temporary salt holding pad at the new HB Mill and then sold. If the salt were unable to be sold, it would be reinjected back into the HB inactive mine workings.

During initial filling, and periods when sufficient quantities of salt are not available from the new HB Mill, tailings produced from the existing Intrepid West facility would be used to condition the injectate solution.

Fresh Caprock water would be used to flush valves, prepare reagents, dilute flotation reagents, support scrubber operations, function as cooling water, and for other in-mill needs. This water would be supplied from an existing permitted source owned by Intrepid. After the fresh Caprock water is used in the new HB Mill, it would be recycled and used to create the slurry at the evaporation ponds, to supplement evaporation pond water, or to supplement injectate water. During the first seven years, up to 267 gpm of Caprock water would be used. During average, steady state mill operations, the Caprock water use is expected to be approximately 208 gpm.

Construction Sequence

The following activities are proposed to be performed, beginning in the order listed, assuming overlap of activities in order to complete all construction within 1.5 years.

1. Relocation of utilities at pond location (power lines, gas lines, fiber optic line)—6 months
2. Earthmoving and installation of facilities for evaporation pond system—15 months
3. Construct HB Mill—15 months
4. Drill wells—6 months
5. Construct pipelines—9 months
6. Install power and other infrastructure for wells and HB Mill—15 months

Flooding and Extraction Sequence

Injection rates are proposed to be approximately 2,000 gpm during initial filling of all mines. Once the flood pools are full, the average injection rate would be approximately 1,054 gpm. The phases and injection and extraction rates are summarized below.

- Phase I: Initial Phase
  - Injection at Maximum Rate (2,000 gpm)—Years 0 – 7
  - No Extraction Years 0 – 0.5
  - Extraction at Average Rate (1,054 gpm)—Years 0.5 – 7
- Phase II: Steady State Phase
  - Injection at Average Rate (1,054 gpm)—Years 8 – 21
  - Extraction at Average Rate (1,054 gpm)—Years 8 – 21
- Phase III: Final Extraction Only Phase
  - No Injection Years 22 – 28
  - Extraction at Average Rate (1,054 gpm)—Years 22 – 28

Summary of Proposed Action

The Proposed Action is estimated to generate approximately 185,000 tons of potash per year once steady state operations (Phase II) are achieved. For construction, it is estimated that a maximum of 274 workers would be employed for at least 3 months, and up to 263 workers would be employed during the second year. During the operations phase, Intrepid would employ 36 workers for the life of the project in addition to its existing work force. The new employees would be hired a few months prior to the initiation of project operations to ensure that they are adequately trained.

Tables 2-3, **2-4**, and **2-5** summarize the projected amount of surface disturbance, amount of new facilities to be constructed and maintained, and the water usage projected under the Proposed Action. Long-term disturbance includes areas that are altered from the native state, and may include areas that are covered with concrete or structures, or bare ground. The acreage of long-term disturbance excludes the areas of initial disturbance that have been reclaimed.

Table 2-3 Surface Disturbance under Proposed Action

Facility	Quantity	Initial Disturbance (acres)	Long-term Disturbance (acres)
New Wells (no.)	21	10	1
Evaporation Ponds (no.)	26	574	522
Diversion Ditches (no.)	2	4	2
Power Lines (mi.)	38	11	0
Lift/Booster Stations (no.)	8	7	2
HB Mill (no.)	1	10	5
New Roads (mi.)	38	82	55
Pipeline burial locations (approx. no.)	151	4	0
Pipeline ROWs (includes roads, pipes, power lines, booster stations) (mi.)	38	229	114
Rerouted Utility ROWs (mi.)	6	42	7
Salt Haul Road (mi.)	2	8	6
Caliche Pits (no.)	6	174	174
Total Disturbance[1]	—	**1,022**	**829**

[1] This is not a sum of the acreage for the facilities listed above because it excludes any overlapping areas, such as where there are well pads within the evaporation pond areas or where the roads occur within the pipeline ROWs.

Table 2-4 Length of Pipeline by Diameter under Alternative A

Pipeline Diameter (inches)	Total Length (miles)
6	24
8	2
14	24
16	30
18	2
Total	**82**

Note: Pipelines listed would be grouped within the 38 miles of 50-foot-wide ROWs.

Table 2-5 Summary of Water Usage under Proposed Action

Water Type/Use	Maximum Water Usage					
	Phase I		Phase II		Phase III	
	afy	gpm	afy	gpm	afy	gpm
Rustler Water for Injectate	3,226	2,000	1,700	1,054	0	0
Caprock Water	431	267	336	208	336	208

Notes:

afy = acre-feet per year (1 acre-foot of water equals 325,581.4 gallons).

Phase I = Years 0 – 7; Phase II = Years 8 – 21; Phase III = Years 22 – 28.

2.4.3 Alternative B—Supplemental Water Sources

Alternative B would include all of the facilities, processes as described for Alternative A, Proposed Action, with the exception of the northernmost Rustler wells and pipelines, which would not be included under this alternative (see **Figure 2-3**). It would include approval of lease modifications described for the Proposed Action. Due to public and agency concerns related to whether there would be enough Rustler water to fill the flood pools in the inactive workings, this alternative incorporates the increased use of Caprock water as a supplemental or primary water source. The northernmost Rustler wells included in Alternative A were not included in this alternative due to concerns over high lead levels that may affect the quality of the potash produced without extensive water treatment prior to injection into the flood pools.

Caprock water from Intrepid's existing wells east of the project area (shown on **Figure 2-4**) would be used whenever the Rustler water supply is inadequate to meet the optimum filling rate of the flood pools. The quantity of Caprock water used would range from approximately 200 gpm to 2,000 gpm in addition to the 208 gpm to 267 gpm of Caprock water to be used for mill processes. Caprock water usage would not exceed Intrepid's existing water rights. Intrepid's water rights appropriation from the State Engineer for the East and HB Caprock well fields is over 7,700 acre-feet, which exceeds the annual maximum proposed Caprock water needs by over 3,200 acre-feet.

There are two existing pipelines from the Caprock well fields with a total length of approximately 66 miles. The following descriptions of these pipelines were derived from an engineering evaluation provided in a memorandum to Intrepid on August 27, 2010 (Ausenco Pipeline Systems Inc. 2010).

- The East Caprock pipeline (the southern Caprock pipeline shown on **Figure 2-4**) is 14-inch inside diameter, cement-lined, and coated with spiral-wound steel that is currently in use to supply approximately 1,400 gpm to Intrepid's East Plant. This pipeline is in fairly good condition with a maximum capacity of approximately 2,200 gpm.
- The HB/Eddy Caprock pipeline (the northern Caprock pipeline shown on **Figure 2-4**) is believed to be a spiral-welded steel pipe with a concrete external coating (no cement lining). This pipeline is approximately 12 inches (inside diameter) and is known to be in poor condition. The maximum capacity is estimated to be 1,000 to 1,400 gpm.

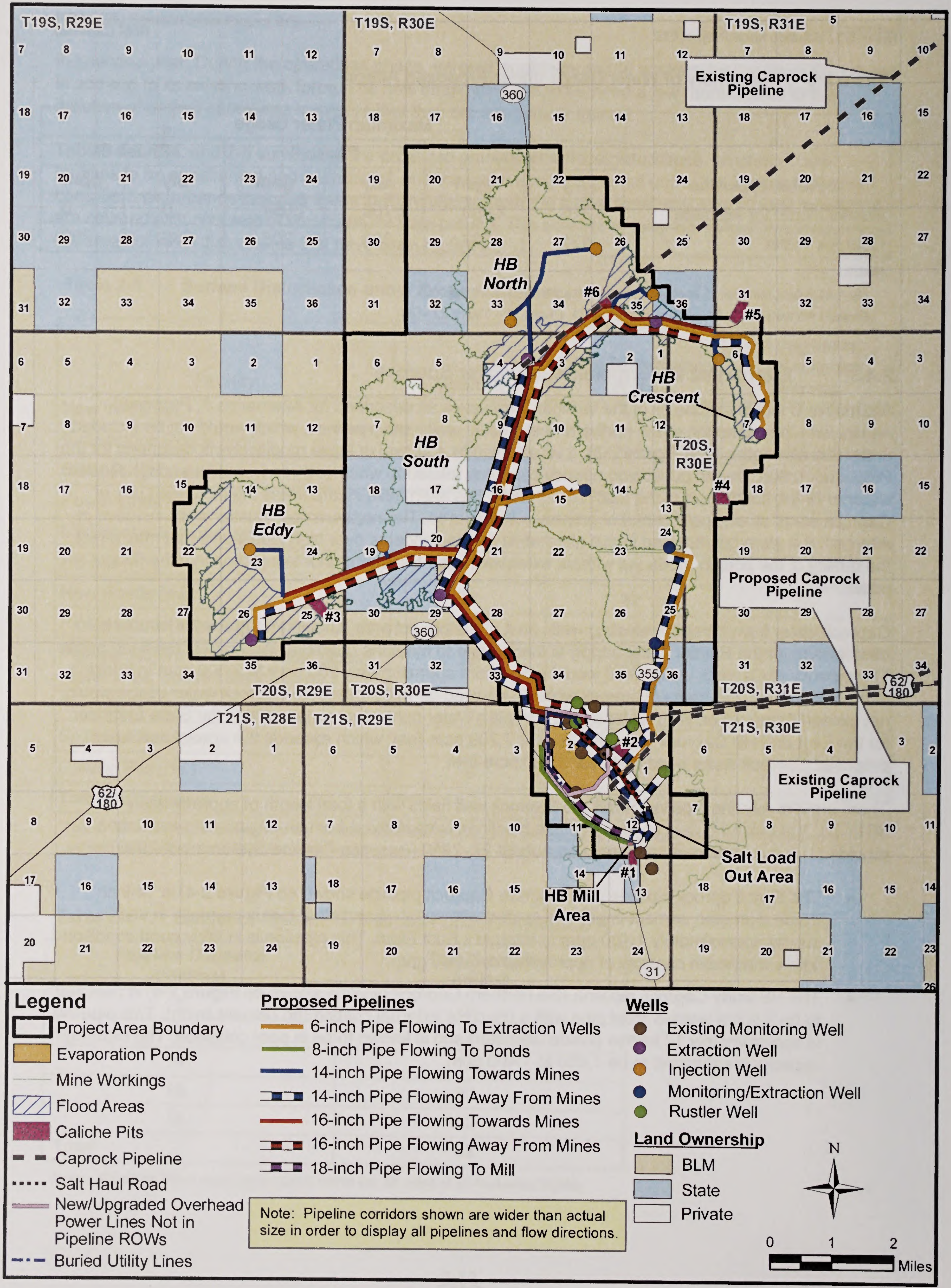

T19S, R29E
T19S, R30E
T19S, R31E
Existing Caprock Pipeline
HB North
#6
#5
HB Crescent
T20S, R30E
#4
HB South
HB Eddy
#3
Proposed Caprock Pipeline
360
355
T20S, R29E
T20S, R30E
T20S, R31E
62/180
T21S, R28E
T21S, R29E
T21S, R30E
#2
Existing Caprock Pipeline
Salt Load Out Area
#1
HB Mill Area
31
Legend
Project Area Boundary
Evaporation Ponds
Mine Workings
Flood Areas
Caliche Pits
Caprock Pipeline
Salt Haul Road
New/Upgraded Overhead Power Lines Not in Pipeline ROWs
Buried Utility Lines
Proposed Pipelines
6-inch Pipe Flowing To Extraction Wells
8-inch Pipe Flowing To Ponds
14-inch Pipe Flowing Towards Mines
14-inch Pipe Flowing Away From Mines
16-inch Pipe Flowing Towards Mines
16-inch Pipe Flowing Away From Mines
18-inch Pipe Flowing To Mill
Note: Pipeline corridors shown are wider than actual size in order to display all pipelines and flow directions.
Wells
Existing Monitoring Well
Extraction Well
Injection Well
Monitoring/Extraction Well
Rustler Well
Land Ownership
BLM
State
Private
N
0
1
2
Miles

Figure 2-3 Alternative B Infrastructure Layout in Project Area

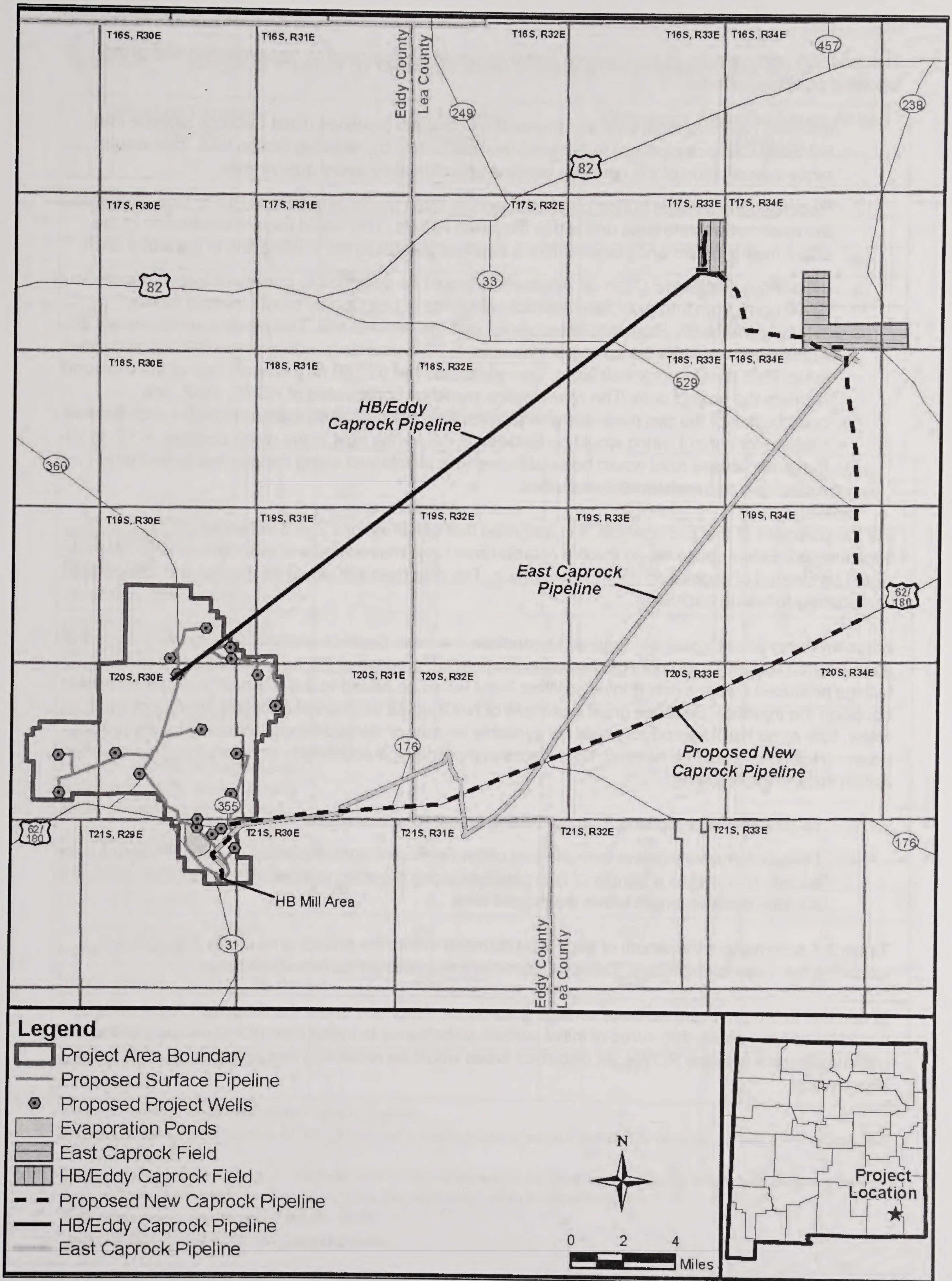


Figure 2-4 Preferred Alternative Infrastructure Layout in Project Area under Alternative B

The reliability and capacity of the Caprock pipelines would be improved by implementing one of the following possible options:

1. Inserting HDPE smooth pipe into the existing concrete pipelines (East Caprock pipeline and HB/Eddy Caprock pipeline) to increase the rate of flow by reducing friction loss. This would require excavation of the concrete pipeline approximately every quarter mile.
2. Replacing the existing buried concrete Caprock main pipelines with new HDPE pipe alongside the existing concrete lines and within the same ROWs. This would require excavation of the entire main pipeline and placement of a new line parallel to the existing line in the same ditch.
3. Installing a single new Caprock pipeline that would be designed to convey all water (maximum of 5,000 gpm) from Intrepid's four Caprock well fields in Lea County to any Intrepid facility, including the North, East, and West plants, and the new HB mill. This pipeline route, shown on **Figure 2-4**, would be buried in a trench at least 30 inches deep within a new ROW that heads south from the Caprock well fields, then parallel to NM 62/180 on the north side of the road until it enters the project area. The new pipeline would be constructed of HDPE, steel, or a combination of the two materials with pipeline diameters up to 36 inches. A 2- to 4-inch-diameter pipeline for control wiring would be installed in the trench next to the water pipeline. A 12- to 15-foot-wide access road would be established and maintained along the pipeline to facilitate monitoring and maintenance activities.

For the purposes of this EIS analysis, it is assumed that either options 2 or 3 above would be implemented. Either option would involve establishment and maintenance of a 50-foot-wide ROW that would be cleared of vegetation prior to excavation. The disturbed soil would be graded and revegetated immediately following backfilling.

Large amounts of salt would be required to condition the fresh Caprock water before injecting it into the flood pools. The NaCl byproduct generated in the flotation process at the new HB Mill and salt from tailings produced by the existing Intrepid West Plant would be added to the Caprock source water to condition the injectate. Because great quantities of NaCl would be needed to create brine from fresh water, little or no NaCl byproduct would be available for sale or reinjection until Phase III of the project when no injectate would be needed. Differences in pipeline type and length, compared to the Proposed Action include the following:

- 14-inch-diameter pipeline from the northernmost Rustler wells has been eliminated.
- 14-inch-diameter pipeline from the end of the northern Caprock pipeline to the HB Mill has been added. This makes a bundle of four pipelines along the main pipeline ROW and adds 9 miles to the total pipeline length within the project area.

Table 2-6 summarizes the length of each pipe diameter within the project area under Alternative B, excluding the Caprock pipelines. **Table 2-7** summarizes projected surface disturbance.

In addition to the projected acres of surface disturbance described under the Proposed Action, there would be approximately 400 acres of initial surface disturbance to install new HDPE pipe within the existing Caprock pipeline ROWs. All disturbed areas would be reclaimed and revegetated after initial disturbance.

Table 2-6 Length of Pipeline by Diameter under Alternative B (within Project Area)

Pipeline Diameter (inches)	Total Length (miles)	Difference from Proposed Action (miles)
6	24	0
8	2	0
14	33	+9
16	30	0
18	2	0
Total	**91**	**+9**

Note: Pipelines listed would be grouped within the 37 miles of 50-foot-wide ROWs within project area. Excludes Caprock pipelines.

Table 2-7 Surface Disturbance under Alternative B

Facility	Quantity	Initial Disturbance (acres)	Long-term Disturbance (acres)
New Wells (no.)	18	8	1
Ponds (no.)	26	574	522
Diversion Ditches (no.)	2	4	2
Lift/Booster Stations (no.)	8	7	2
HB Mill (no.)	1	10	5
New Roads (mi.)	37	81	54
Pipeline burial locations (approx. no.)	149	4	0
Pipeline ROWs in project area (includes roads, pipes, power lines, booster stations) (mi.)	37	226	113
Rerouted Utility ROWs (mi.)	6	42	7
Salt Haul Road (mi.)	2	8	6
Caliche Pits (no.)	6	174	174
Existing Caprock Pipeline replacement (mi.)	66	400[1]	0
New Caprock Pipeline (mi.)[2]	46	279[2]	84
Total Maximum Surface Disturbance[3] (ac.)	—	**1,435[4]**	**914[5]**
Difference from Proposed Action (ac.)		**+413**	**+85**

[1] Maximum acreage of disturbance for Caprock pipelines.

[2] Acreage of new Caprock pipeline ROW; not included in total acreage of surface disturbance because it is less than the maximum under this alternative.

[3] This is not a sum of the acreage for the facilities listed above because it excludes any overlapping areas, such as where there are wells within the evaporation pond areas or where the roads occur within the pipeline ROWs.

[4] Total within project area boundary is 1,022 acres.

[5] Includes access road along new Caprock pipeline.

A primary difference between Alternative B and the Proposed Action is the increased use of Caprock water to supplement the saline water from the Rustler wells to ensure adequate continuous supplies of water to fill the flood pools. **Table 2-8** summarizes the maximum volume of Rustler and Caprock water to be analyzed under this alternative. The maximum total water usage of 2,267 gpm would not be exceeded at any one time. That maximum total water usage may be supplied by Caprock water, Rustler water, or any combination of the two sources up to the maximums listed in the table.

Table 2-8 Summary of Maximum Water Usage under Alternative B

	Maximum Water Usage					
	Phase I		**Phase II**		**Phase III**	
Water Type/Use	**afy**	**gpm**	**afy**	**gpm**	**afy**	**gpm**
Rustler Water for Injectate	1,242	770	1,242	770	0	0
Caprock Water	3,226	2,000	1,700	1,054	336	208

Notes:

1 acre-foot of water equals 325,581.4 gallons.

Phase I = Years 0 – 7; Phase II = Years 8 – 21; Phase III = Years 22 – 28.

2.4.4 Alternative C—Buried Pipelines

This alternative would approve Intrepid's mine operation plan, grant ROWs with modifications designed to limit surface facilities, and approve lease modifications. All pipelines would be buried within the pipeline ROW. The layout of the pipeline system and the proposed pumping of groundwater from Rustler Formation wells in the project area would be the same as that described for Alternative A, Proposed Action. More excavation would be required but the total acreage of surface disturbance would be the same as that described for the Proposed Action due to the clearing of vegetation and grading required within the ROWs under Alternative C. Vegetation disturbed for installation of pipelines in the project area would be reestablished, but the access roads would be constructed and maintained in the pipeline ROWs for monitoring. There would be less long-term bare ground and no surface pipelines, but all other aspects of the implementing the Proposed Action would be the same.

2.4.5 Alternative D—Preferred Alternative

According to CEQ's NEPA regulations at 40 CFR Section 1502.14(e), the agency's preferred alternative should be identified in the Final EIS. The BLM selected aspects of Alternatives B and C to be included in the Preferred Alternative. This alternative includes approval of Intrepid's revised HB In-Situ Solution Mine Operation and Closure Plan, granting new ROWs, approval of lease modifications, and approval of permits to drill new water supply, injection, extraction, and monitoring wells. All of the process plans would be the same as described for Alternative A—Proposed Action but there would be some adjustments to the construction schedule. In general, the construction schedule would take two years. Utility relocation and installation of the wells and pipelines in the project area would begin in the first quarter following project approval, followed by construction of the evaporation ponds, construction of the power infrastructure, then the HB Mill.

Under the Preferred Alternative, the BLM would modify 12,867 acres of Intrepid's potash leases to be classified as solution mining leases instead of conventional mining leases. This change would exclude all leases that touch the flood area from the 96,000-acre cap under 43 CFR §3503.37, as amended. Approval of this lease modification is justified because the leases containing the flood pools could not be used for conventional mining in the future.

Under this alternative, four Rustler wells would be drilled within Sections 1 and 2 of T21S, R29E, to the north and east of the proposed evaporation ponds. To avoid karst features, the surface pipelines over the HB Eddy inactive workings have been slightly rerouted compared to the Proposed Action layout. Due to new information on pipe design and power company requirements for efficient delivery of electricity to the project components, other adjustments to the layout of the pipeline bundles within the project area are considered under the Preferred Alternative that are slightly different than the layout originally proposed as part of the Proposed Action and Alternatives B and C. See **Figure 2-5** for the revised pipeline layout.

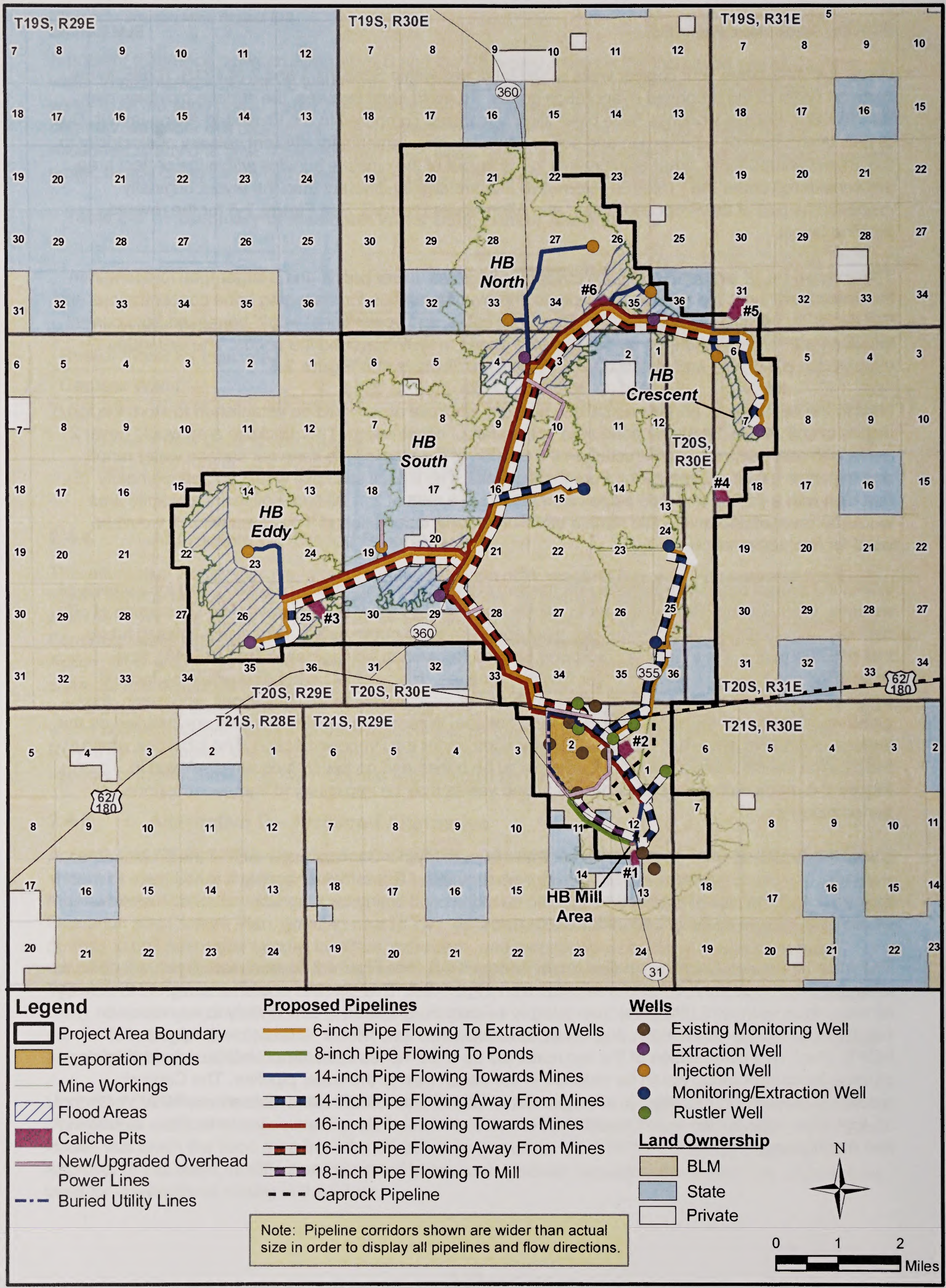
There would be 18 evaporation ponds covering 584 acres, fewer ponds and a larger total footprint than that described under the Proposed Action, to improve capabilities for managing brine concentrations and salt deposits. Existing utilities (gas line, fiber optic cable, and power lines) would be moved from current locations within the boundaries of the proposed ponds to ROWs around the ponds. The expanded evaporation pond area and rerouted utility ROWs are displayed on **Figure 2-5**.

Next to the evaporation ponds and caliche pit #2, a stockpile area would be established to store the top 6 inches of soil stripped from the pond area at the start of construction. This stockpile area would cover 21 acres with earthen berms constructed on the outside of the stockpile to keep out surface water runoff and minimize offsite sedimentation from the stockpile. The topsoil stockpile would be approximately 15 feet high with a flat top and side slopes constructed at a ratio of 2:1. All bare soil in the stockpile area would be revegetated and would remain undisturbed until completion of the project when it would be used for final reclamation.

Within the project area, approximately 68 percent of the pipeline bundles would be buried for a variety of reasons, including minimizing barriers to wildlife and livestock movements, preventing obstruction of off-highway vehicle (OHV) traffic by surface pipelines to improve public safety, minimizing limits to future trail development in the vicinity of Hackberry Special Recreation Management Area (SRMA), and minimizing obstruction of surface water flow in drainages. Where pipeline bundles would be located within or adjacent to other disturbed areas such as the evaporation ponds, fencelines, and roads, the pipes would be permitted to be installed on the surface. Where long pipeline bundles are installed on the surface, segments would still be buried as described under the Proposed Action. The locations where the pipeline bundles within the project area would be buried and on the surface are displayed in **Figure 2-6**. Additional monitoring equipment and valves may be necessary to improve monitoring of buried pipelines.

Under the Preferred Alternative, additional water from Intrepid's Caprock wells east of the project area would be used to supplement the saline water whenever the Rustler water supply is inadequate to meet the optimum filling rate of the flood pools. The quantities and timing of using Caprock and Rustler water would be the same as described under Alternative B.

The route of the new Caprock pipeline under Alternative B (see **Figure 2-4**) has been slightly modified to minimize impacts to sand dune lizards, shown on **Figure 2-7**. This pipeline would be designed to convey all water (maximum of 5,000 gpm) from Intrepid's Caprock well fields in Lea County to any Intrepid facility, including the North, East, and West plants, and the new HB mill. It would be constructed of HDPE, steel, or a combination of the two materials up to 36 inches in diameter. A 2- to 4-inch-diameter pipeline for control wiring would be installed in the trench next to the water pipeline. The Caprock pipeline bundle would be buried in a trench with at least 30 inches of cover within a new ROW. A 12- to 15-foot-wide access road would be established and maintained along the pipeline to facilitate monitoring and maintenance activities.



Note: Pipeline corridors shown are wider than actual size in order to display all pipelines and flow directions.

Figure 2-5 Preferred Alternative Infrastructure Layout in Project Area

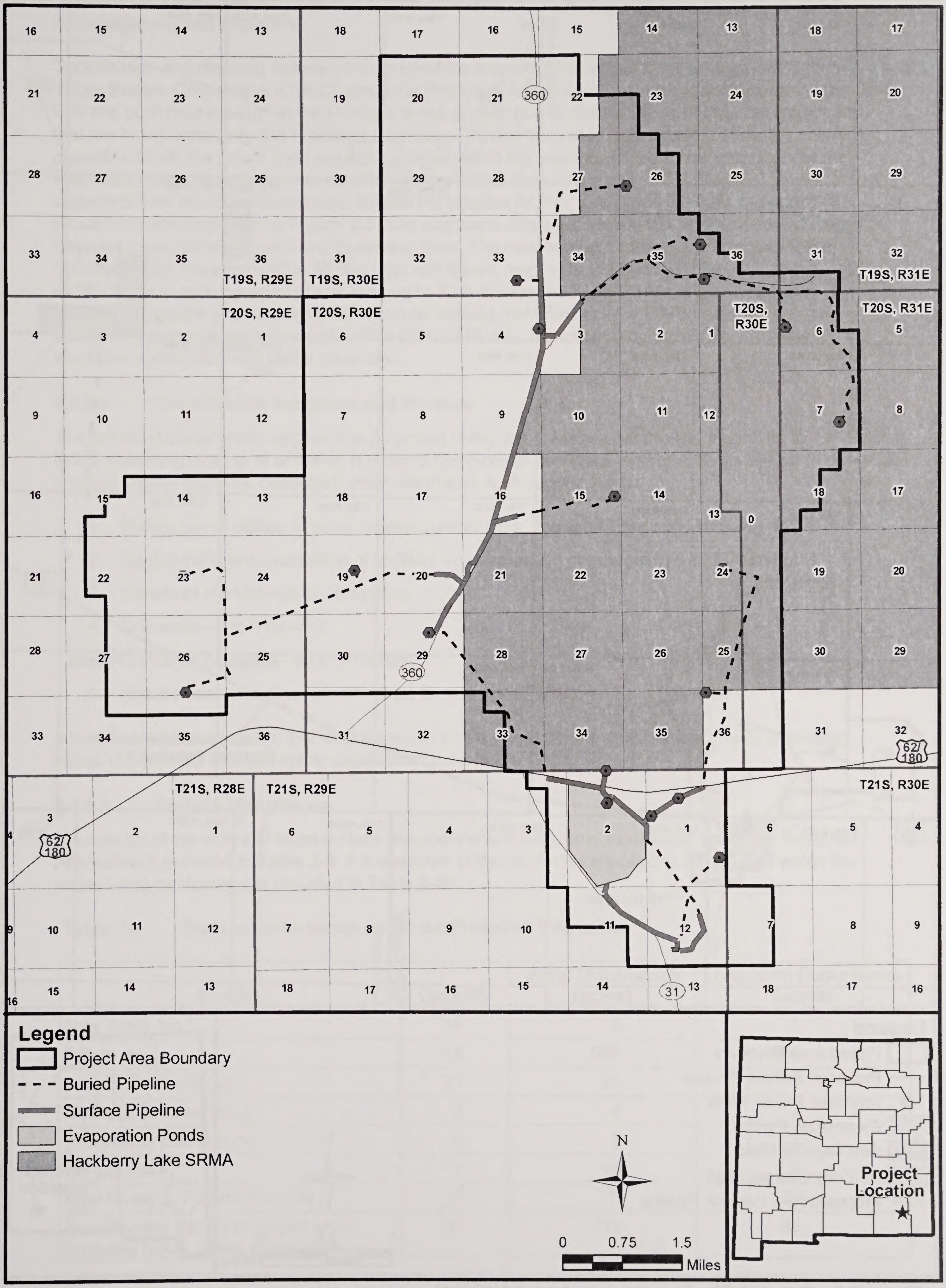


Figure 2-6 Surface and Buried Pipelines in Project Area under Preferred Alternative

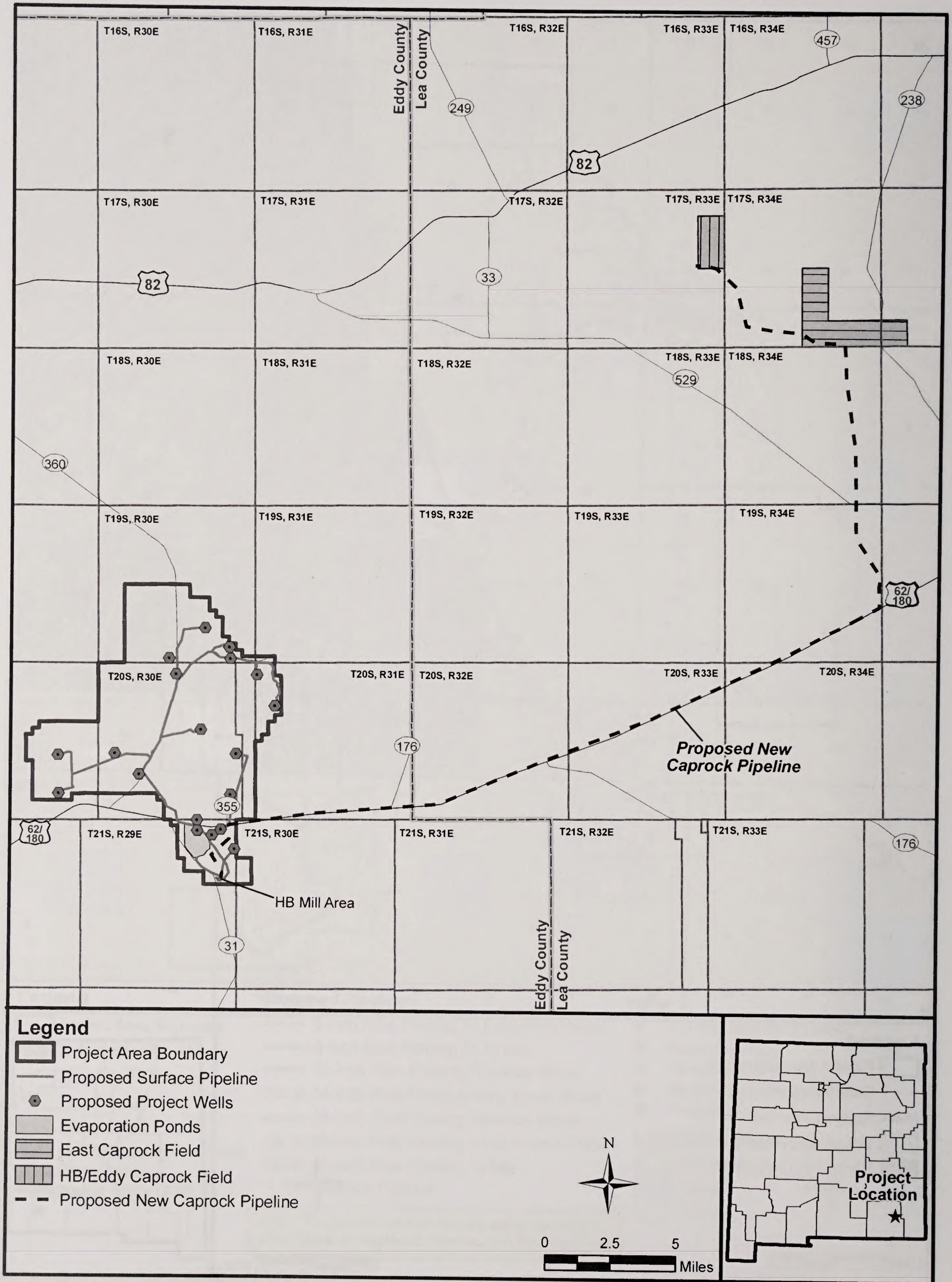


Figure 2-7 Caprock Pipeline under Preferred Alternative

Coordination and planning between Intrepid and the two power providers (Xcel Energy and Central Valley Electric Cooperative [CVEC]) since the Proposed Action was presented to the public and the Draft EIS was published resulted in the changes to the original power distribution system in the project area that are incorporated into the Preferred Alternative. Where Intrepid is responsible for running power to project facilities, the power lines would be located within the pipeline ROWs as described under the Proposed Action. In order to connect with existing power lines operated by Xcel or CVEC, some new or upgraded lines would be constructed outside the pipeline ROWs. The proposed new and upgraded power lines are displayed on **Figure 2-5**. The segments displayed are shown as disconnected segments because they connect at each end to existing lines. The new and upgraded power lines would be constructed on poles from 40 to 45 feet high with spans ranging from 250 to 350 feet between poles. ROWs for new and upgraded power lines up to 30-feet wide would be bladed, then revegetated. To facilitate inspection and maintenance, a natural surface, two-track road would be established and maintained along all power lines not within pipeline ROWs. All new and upgraded transmission lines would be constructed with raptor protection.

2.4.5.1 Construction Sequence and Workers

The following construction sequence is proposed under the Preferred Alternative, beginning in the order listed, assuming overlap of activities in order to complete all construction over a 20- to 24-month period. It varies slightly from that described under Alternative A, Proposed Action.

1. Relocation of utilities at pond location (power lines, gas lines, fiber optic line)—up to 6 months
2. Earthmoving and installation of facilities for evaporation pond system—15 to 18 months
3. Construct HB Mill—15 to 18 months
4. Drill wells—6 to 9 months
5. Construct pipelines—up to 9 months
6. Install power and other infrastructure for wells and HB Mill—15 to 18 months

It is estimated that a peak of 272 workers would be employed for the construction phase, averaging about 155 workers over the entire construction schedule.

2.4.5.2 Surface Disturbance

A summary of the extent of initial surface disturbance and long-term disturbance under the Preferred Alternative is provided in **Table 2-9**. A breakdown of the pipelines proposed to be installed within the project area by diameter is provided in **Table 2-10**.

Table 2-9 Surface Disturbance under the Preferred Alternative

Facility	Quantity	Initial Disturbance (acres)	Long-term Disturbance (acres)
New Wells (no.)	18	8	1
Ponds (no.)	18	584	584
Topsoil Stockpile (ac.)	21	21	0
Diversion Ditches (no.)	2	4	2
Lift/Booster Stations (no.)	8	7	2
HB Mill (no.)	1	10	5
New Roads in Project Area (mi.)	35	76	54
New Pipeline ROWs in project area (includes roads, pipes, power lines,	35	212	68

Table 2-9 Surface Disturbance under the Preferred Alternative

Facility	Quantity	Initial Disturbance (acres)	Long-term Disturbance (acres)
booster stations) (mi.)			
Rerouted Utility ROWs (mi.)	6	42	7
New and Upgraded Power line ROWs (includes access roads) (mi.)			
Caliche Pits (no.)	6	174	174
New Caprock Pipeline (mi.)	47	285	85[3]
Total Maximum Surface Disturbance[1] (ac.)	—	**1,331[2]**	**962[2]**
Difference from Proposed Action (ac.)		**+309**	**+133**

[1] This is not a sum of the acreage for the facilities listed above because it excludes any overlapping areas, such as where there are wells within the evaporation pond areas or where the roads occur within the pipeline ROWs.

[2] Totals within project area boundary are 1,071 acres initial disturbance and 882 acres long-term disturbance.

[3] Includes access road along new Caprock pipeline.

Table 2-10 Length of Pipeline in Project Area by Diameter under Preferred Alternative

Pipeline Diameter (inches)	Total Length (miles)
6	24
8	1
14	19
16	30
18	1
Total	75

Note: Pipelines listed would be grouped in bundles within the 35 miles of 50-foot-wide ROWs.

2.4.6 Environmental Protection Measures Common to All Alternatives

Intrepid would adhere to all lease conditions, in addition to all relevant federal and state laws, regulations, and policies under all alternatives. Additional environmental protection and mitigation measures may be identified during the EIS process. The following measures would be implemented, as needed depending on site-specific conditions, under any of the action alternatives to protect the human environment.

Other Federal Permits and Requirements

- NPDES Construction General Permit—where 1 acre or more of land is disturbed, this permit, implemented by the U.S. Environmental Protection Agency (USEPA), requires the development and implementation of storm water pollution prevention plans (SWPPPs) to prevent sediment and other pollutants from being discharged in storm water runoff. Implementation includes establishment of erosion and sediment controls, temporary and permanent soil stabilization, storm water control structures, measures to keep construction sites clean.

- Consultation with the USFWS under the ESA—assess whether the proposed activities would jeopardize the existence of endangered or threatened species or their critical habitat.
- NHPA and Executive Order (EO) 13175, and other laws pertaining to tribal coordination and management of cultural resources—identify and mitigate impacts to cultural resources that may be affected by proposed project and coordinate with tribes and pueblos that have an interest in the area.
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations—evaluate the potential for impacts to minority and low-income populations.
- Safe Drinking Water Act, Part C (42 USC 300h et seq.) —regulates the installation and management of underground injection control wells and is managed by the New Mexico Environment Department (NMED).

State Permits and Requirements

- Discharge Permit under the New Mexico Water Quality Act, Groundwater and Surface Water Protection (20.6.2 NMAC regulations)—control the discharges of water contaminants from the injection wells, extraction wells, evaporation ponds, potash processing mill, and brine management facility into groundwater and surface water under the terms and conditions of this permit issued by NMED, Water Quality Bureau.
- Construction and Operating Permits under the New Mexico Air Quality Control Act and regulations (20 NMAC 2.72)—control the emission of criteria pollutants (such as nitrogen oxides [NO_X] and carbon monoxide [CO]) that exceed designated limits under the terms and conditions of permits issued by NMED, Air Quality Bureau.
- ROW Easement approval on New Mexico State Land—ROWs on state land must be approved for pipelines, roads, and power lines. The terms and conditions of the granted ROW require that the operator preserve and protect the natural environmental conditions of the land, including reclamation of disturbed areas and revegetation. Roads must meet specific state standards.
- Archaeological Permit under the Cultural Properties Act (Section 18-6-9 NMSA 1978, as amended)—archaeological field surveys to be completed prior to issuance of ROW on state land or earthmoving where there are archaeological sites on state land and privately owned land in New Mexico.

Applicant-committed Environmental Protection Measures

- A subsidence monitoring plan would be finalized and implemented by Intrepid to identify and evaluate any land subsidence in the project area. Monitoring points have already been established with BLM approval, and these locations would be surveyed prior to groundwater extraction and flood pool filling in order to establish baseline values for ground surface elevations.
- A groundwater monitoring plan would be developed by Intrepid and approved by the BLM prior to project implementation. The monitoring plan would describe how the monitoring wells would be operated to evaluate groundwater drawdown and the process for managing water usage as water levels in the wells and groundwater levels vary. Monitoring wells also would be used to identify potential depletions of existing springs, wells, and other water bodies that may result from project pumping.

- Siting of facilities would be completed in coordination with BLM resource specialists to ensure that adverse impacts to significant natural and cultural resources are avoided or otherwise mitigated.
    - All facilities would be monitored on a regular basis and controlled through regular field inspection and the use of automated sensing and shutdown equipment at strategic locations to minimize the potential for discharges or leaks. All monitoring, spill response, and remedial actions would comply with the items described in detail in Intrepid's HB In-Situ Solution Mine Operations and Closure Plan submitted to the BLM.
- Rustler production wells
    - Well pads would be fenced to exclude access by people or animals.
    - Work surface would be stabilized with concrete or caliche.
    - Area surrounding well pads would be bermed to contain any spills and to protect well casing integrity.
    - Backflow preventers would be installed to protect well integrity.
- Injection and extraction wells
    - Well management would be subject to terms and conditions of the NMED Discharge Permit.
    - Well casings would be constructed to exceed Class III well standards. Casing materials would be designed to function in a highly saline environment.
    - Well annular space and column pressure-sensing equipment would be installed.
    - Well pads would be fenced to exclude access by people or animals.
    - Work surface would be stabilized with concrete.
    - Automated monitoring system would be installed to support operations and maintain underground workings flood elevations.
- New monitoring/extraction wells
    - Wells would be sited and designed to detect the presence of underground brine flowing from the flooded mine workings.
    - Each of the three wells would be equipped with automated monitoring systems to detect and report any brines outside the flooded mine workings.
    - Each well would be equipped with the equipment (pumps, power, pipelines, etc.) needed to extract brine that migrates outside the flood pools to prevent a structural or safety problem.
    - In the event that a monitoring well detects brine outside the flooded workings, these wells would act as a safeguard by detecting and extracting "escaped" brine.
- All automated processes would be inspected, calibrated, and verified based on a regular inspection schedule to be established through a field operation and maintenance plan.
- Pipelines
    - Pipelines would avoid steep slopes.
    - Where pipelines must cross major roadways, the pipe would be installed by boring under the road to minimize traffic disruption.
    - Wherever possible, pipeline ROWs would be located along existing roads or other ROWs to limit surface impacts to already disturbed areas.
    - Automated sensing and shutdown equipment would be installed along the pipelines to minimize the potential for discharges or leaks of the transported brines.

  - The pipelines would be inspected regularly in the field. All monitoring, spill response, and remedial actions would comply with the items described in detail in HB In-Situ Solution Mine Operations and Closure Plan submitted to the BLM.
- Lift and booster stations—All designs would include check valves to account for anti-backflow or siphon conditions and instrumentation to monitor pipeline performance and adjust interdependent flow rates and pressures.
- Power lines—Anti-perch equipment and other raptor protection would be installed on new power lines.
- Roads
  - Vehicle access would utilize existing roads where possible.
  - Pipeline inspection roads to be constructed would be limited to a 12-foot width.
  - Where needed to maintain stable roads and minimize soil erosion, a base of up to 6 inches of crushed caliche would be placed on the running surface.
- Evaporation ponds
  - Ponds would be lined with geosynthetic liners to be covered by an 18-inch-thick layer of salt that would harden to provide protection for the liner and minimize the potential for leaks. Salt would come from existing tailings piles.
  - Ponds would be constructed with freeboard to minimize the potential for overtopping and spills.
- Reclamation following project completion
  - All wells would be plugged and abandoned in accordance with applicable rules and regulations.
  - All pond liners would be shredded and either buried onsite or removed to a permitted landfill.
  - The hardened salt layer on top of the pond liners would be excavated and disposed of according to the requirements of the NMED discharge permit.
  - All ancillary equipment would be demolished, razed, and recycled or transported to a permitted landfill for proper disposal.
  - Following the removal of all structures and infrastructure, disturbed areas would be graded and planted with native seed mixtures. Site preparation, planting, and monitoring would be performed in consultation with the BLM, with a goal of returning the property to beneficial post-mining land uses similar to pre-project conditions.

BLM Carlsbad Field Office Requirements

In addition to compliance with agency-wide and statewide BLM policies, regulations, and guidelines, the Carlsbad Field Office has developed measures and guidance designed to minimize adverse impacts to natural and cultural resources from mineral development activities in the field office area. One design feature that would be required under all action alternatives is the designation of a person onsite to monitor construction activities for compliance with federal and state permits and requirements, such as the implementation of plans required by permits and mitigation measures identified in the ROD. This construction monitor would report to the BLM on a regular basis.

In compliance with federal regulations, the BLM will set a reclamation bond for the project sufficient to ensure that reclamation is completed at the end of the project lifespan.

Table 2-9 provides a summary of the lease stipulations and environmental protection measures required by BLM policy and guidelines that would continue to be implemented within the SPA. These measures would be applied as needed, depending on site-specific conditions to be determined by BLM resource specialists. The requirements with reference numbers starting with the number 1 are existing potash lease stipulations. The other items in the table apply more broadly to any activities in the area. More complete descriptions of these measures are included in **Appendix B**, which also contains seed mixtures developed for specific ecological sites that are currently in use in the area.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
1.1.1	Damage Indemnity	General	Indemnifies the federal government and the BLM against damages.
1.1.2	Compliance with Laws and Regulations	General	Requires the lessee to comply with all existing and future laws.
1.1.3	Oil and Gas Production	General	Lessee shall not unreasonably interfere with oil and gas production.
1.1.4	Pollution Removal	General	Lessee is responsible for any pollution discharged by their operations.
1.1.5	Wood and Plant Removal	General	No fuel woods or live plants may be removed.
1.1.6	Mineral Removal	General	No minerals may be removed without the appropriate permit.
1.1.7	Antiquities	General	Collection, removal, or damaging of antiquities is prohibited.
1.1.8	Cultural Resources	General	All cultural or paleontological resources discovered must be reported to the BLM immediately.
1.1.9	Cultural Survey	General	A cultural survey must be conducted and accepted by the the BLM prior to construction.
1.1.10	New Construction	General	Written approval must be obtained from the BLM prior to any construction not previously approved.
1.1.11	Fences	General	Fences must not be damaged during construction or must be repaired.
1.1.12	Gates	General	Gates and cattle guards on public lands may not be closed to public use. Gates must be kept shut to contain cattle.
1.1.13	Surface Owner Notification	General	The surface owner or grazing allottee must be notified prior to construction.
1.1.14	Scattering	General	Soil, rock, and vegetation debris must be scattered not piled.
1.1.15	Blading	General	Blading will be minimized.
1.1.16	Pits	General	After construction is completed, all pits, other than those permitted for producing mineral materials, must be backfilled.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
1.1.17	Trash	General	All trash must be hauled to an approved dump site.
1.1.18	Concrete	General	No concrete shall be dumped on federal land.
1.1.19	Noxious Weeds	General	The lessee is responsible for preventing the establishment of any noxious weeds or treating to eliminate weeds.
1.1.20	Painting	General	Structures must be painted with a BLM-approved color.
1.2.1	Road Width and Grade	Roads	Specifications for allowable road width and grade.
1.2.2	Surface Disturbance Width	Roads	Specifications for allowable surface disturbance width.
1.2.3	Cattle Guards	Roads	Requirements for cattle guards.
1.4.1	Core Hole Reclamation	Reclamation	Requirements and specifications for core hole reclamation.
1.4.2	Road and Site Reclamation	Reclamation	Specifications and requirements for road and site reclamation.
1.4.3	Facility Reclamation	Reclamation	Any surface structures must be removed at the end of operation.
1.4.4	Hazardous Waste Removal	Reclamation	Hazardous waste must be removed by the lessee by an approved method.
1.4.5.1	Seeding Techniques	Reclamation	Requirements for seeding.
1.4.5.2	Seed Mixture	Reclamation	Seed mixture specification.
1.4.5.3	Soil Preparation	Reclamation	Requirements for soil preparation prior to reclamation planting.
2.1.1	Damage Indemnity	General	Indemnifies the federal governmental and the BLM against damages.
2.1.2	Toxic Substances Control Act Compliance	General	Lessee will comply with TOSCA.
2.1.3	Hazardous Waste Indemnity	General	Indemnifies the federal government and the BLM against damages from toxic waste.
2.1.4	Fences	General	Fences must not be damaged during construction or must be repaired.
2.1.5	Scattering	General	Soil, rock, and vegetation debris must be scattered not piled.
2.1.6	Erosion Control Structures	General	Holder will install erosion control structures where required to stabilize soil.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
2.1.7	Reseeding	General	The holder will reseed disturbed areas.
2.1.8	Painting Requirements	General	Painting requirements and specification.
2.1.9	Cultural Resource Requirements	General	All cultural or paleontological resource discovered must be reported to the BLM immediately.
2.1.10	Native American Graves Protection and Repatriation Act (NAGPRA)	General	Holder must comply with the NAGPRA.
2.1.11	Pollution Removal	General	Oil or other pollutant spills must be cleaned up.
2.2.1.1	Right-Of-Way	Pipelines	Construction activity is confined to the authorized ROW.
2.2.1.2	Signage	Pipelines	Sign requirements for pipelines.
2.2.2.1	Cover	Pipelines	Pipelines must be buried 24 inches deep.
2.2.2.2	Blading Requirements	Pipelines	Blading requirements for buried pipelines.
2.2.3.1	Damage Liability	Surface Pipeline	Holder is liable for damage to the U.S.
2.2.3.2	Right-Of-Way	Surface Pipeline	Construction activity is confined to the authorized ROW.
2.2.3.3	No Blading without approval	Surface Pipeline	Blading for surface pipelines is not allowed without approval.
2.2.3.4	Minimize Suspension	Surface Pipeline	Suspension of surface pipelines over low areas will be minimized.
2.2.3.5	Crossing Burial	Surface Pipeline	Requirements for burying surface pipelines at road crossings.
2.3.1	Karst Features	Cave/Karst	The BLM is to be informed of any subsurface features encountered during construction.
2.3.2	Surface Disturbance Buffer	Cave/Karst	Surface disturbance is not allowed within 200 meters of known cave entrances or significant karst features.
2.3.3	Oil and Gas	Cave/Karst	Guidelines for oil and gas drilling and production in karst areas.
2.3.4	Protection Protocols	Cave/Karst	Cave and karst features will be avoided.
2.3.5	Aquifer Recharge	Cave/Karst	Cave and karst features with significant aquifer recharge have special requirements for construction.
2.3.6	Cave/Karst Construction Mitigation	Cave/Karst	Construction requirements for cave/karst areas.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
2.3.7	Cave/Karst Drilling Mitigation	Cave/Karst	Drilling requirements for cave/karst areas.
2.4.1	Invasive Plant Species	Roads	ROWs must be kept clear of invasive plants.
2.4.2	Road Width and Grade	Roads	Specifications for allowable road width and grade.
2.4.3	Crowning and Ditching	Roads	Crowning and ditching requirements.
2.4.4	Drainage	Roads	Drainage requirements for roads.
2.4.4.1	Lead-off Ditches	Roads	Lead-off ditch specifications.
2.4.4.2	Culvert Pipes	Roads	Culvert pipe specifications.
2.4.4.3	Drainage Dips	Roads	Drainage dip specifications.
2.4.5	Turnouts	Roads	Turnout requirements for roads.
2.4.6	Surfacing	Roads	Surfacing requirements for roads.
2.4.7	Cattleguard Requirements	Roads	Requirements for cattle guards.
2.4.8	Maintenance	Roads	The holder shall maintain the road in a safe and usable condition.
2.4.9	Public Access	Roads	Public access may not be restricted.
2.5.1.1	No Blading of Power Line ROWs	Power Lines	No clearing or blading of ROWs.
2.5.1.2	Power Line Signs	Power Lines	Signage requirements for power lines.
2.5.1.3	Abandonment	Power Lines	Holder must follow prescribed abandonment procedures.
2.5.1.4	Removal of Surface Structures	Power Lines	All surface structures must be removed within 180 days of abandonment.
2.5.2.1	Raptor Protection	Power Lines	Pipelines shall be "raptor safe."
2.5.2.2	Special Power Line Stipulations	Power Lines	Dispose of poles lines and transformers properly, fill in holes, limit all disturbance to authorized ROW.
2.5.3.1	Noxious Weeds	Power Lines	Holder shall ensure that construction equipment does not spread noxious weeds.
2.5.3.2	Waste Disposal	Power Lines	Holder shall ensure that the site is maintained in sanitary condition and that waste is disposed of properly.
2.5.3.3	Limits	Power Lines	Holder shall conduct all activities within authorized limits.
2.5.3.4	Construction Trenches	Power Lines	Trenches shall be covered at night.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
2.5.3.5	Excavated Soil	Power Lines	Excess soil shall be evenly spread in the immediate vicinity of the excavation.
2.5.3.6	Special Buried Power Line Stipulations	Power Lines	Special requirements for buried power lines.
2.6.1.1	Interim Reclamation	Reclamation	All areas not needed for operations shall be reclaimed.
2.6.1.2	Reduction Strategy	Reclamation	Within 6 months of well completion, the holder will devise a strategy for interim reclamation.
2.6.1.3	Caliche Removal	Reclamation	Any caliche used in construction will be removed.
2.6.1.4	Reseeding Requirements	Reclamation	All disturbed areas will be reseeded.
2.6.1.5	Sundry Notice	Reclamation	A sundry notice will be submitted when reclamation is complete.
2.6.2.1	Final Reclamation	Reclamation	Final reclamation must occur after final abandonment.
2.6.2.2	Earthwork	Reclamation	Earthwork for final reclamation must be completed within 6 months of well plugging.
2.6.2.3	Revegetation	Reclamation	All disturbed areas will be reseeded.
2.6.2.4	Contact BLM prior to Abandonment	Reclamation	Operator shall contact the BLM prior to surface abandonment operations.
2.6.2.5	Abandoned Well Marker (Raptor Perching)	Reclamation	A ground level abandoned well marker shall be used to avoid raptor perching.
2.7.1	RMP Guidelines	Recreation	The rules in the 1997 RMPA will be followed.
2.7.2	Pipeline and Power Line Recreation Mitigation	Recreation	Specifications for pipelines and power lines in recreation areas.
2.8.1	Standard Range Practices	Range	Standard practices must be followed to minimize impacts to rangeland.
2.8.2	Livestock Watering Requirement	Range	Avoid or move livestock watering structures.
2.9.1	Reclamation Requirements	Visual Resources	Reclaim infrastructure to eliminate visual impacts.
2.9.2	Low Profile Facilities	Visual Resources	All permanent structures will be low profile.
2.10.1	Slopes or Fragile Soils	Soil	Surface disturbance will not be allowed on slopes over 30 percent.
2.10.2.1	Standard ROW Practices	Soil ROW	Reduce impacts to soil by following standard practices.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
2.10.2.2	ROW Mitigation	Soil ROW	Methods to minimize impacts including no blading, minimize traffic, temporary erosion control measures, etc.
2.10.3.1	Well Pad Standard Practices	Soil Well Pads	Reduce impacts to soil by following standard practices.
2.10.3.2	Well Pad Mitigation	Soil Well Pads	Mitigation measures for well pads.
2.11.1.1	Raptor Nests and Heronries	Wildlife	No surface disturbance within 200 meters of heronries.
2.11.1.2	Prairie Dog Towns	Wildlife	No surface disturbance within known prairie dog towns.
2.11.2.1.1	Lesser Prairie Chicken Timing Limitation	Wildlife	Timing limitations within lesser prairie chicken habitat.
2.11.2.1.2	Ground Level Dry Hole Markers	Wildlife	Ground level dry hole markers are required in prairie chicken habitat.
2.11.2.2	Sand Dune Lizards	Wildlife	No surface disturbance within occupied habitat areas.
2.12.1	Streams, Rivers and Floodplains	Watershed	No surface disturbance within 200 meters of 100-year floodplain.
2.12.2	Playas and Alkali Lakes	Watershed	No surface disturbance within 200 meters of playas or alkali lakes.
2.12.3	Standard Practices to Protect Watersheds	Watershed	Standard practices to protect watersheds.
2.12.4	Mitigation Measures To protect Watersheds	Watershed	Standard mitigation measures to protect watersheds.
2.12.5	Tank Batteries	Watershed	Requirements for tank batteries.
2.12.6	Surface Pipelines (Leak Detection Plan)	Watershed	A leak detection plan will be submitted to the BLM prior to construction.
2.13.1.1	Standard Practices to Reduce Impacts to Vegetation from Well Pads	Vegetation Well Pads	Standard practices to protect vegetation.
2.13.1.2	Mitigation to Reduce Impacts to Vegetation from Well Pads	Vegetation Well Pads	Caliche will be removed from well pads during reclamation.
2.13.2.1	Standard Practices to Reduce Impacts to Vegetation from ROWs	Vegetation ROW	Impacts to vegetation will be reduced by following standard practices.
2.13.2.2	Mitigation to Reduce Impacts to Vegetation from ROWs	Vegetation ROW	Mitigation measures to reduce vegetation impacts.
2.14.1	Mitigation for Weeds	Noxious Weeds	Mitigation measures to reduce the impact of noxious weeds.

Table 2-9 Summary of BLM Environmental Requirements in the SPA

Reference #	Title	Purpose	Description[1]
2.14.2.1	African Rue (*Peganum harmala*)	Noxious Weeds	Operator is responsible if noxious weeds become established.
2.14.2.2	Spraying	Noxious Weeds	Spraying specifications for African rue.
2.14.2.3	African Rue Management Practices	Noxious Weeds	Management practices for African rue.
2.15.1	Archaeological, Paleontological, and Historical Sites	Archaeology	All cultural or paleontological resource discovered must be reported to the BLM.
2.15.2	Historic Properties	Archaeology	Historic properties are protected by law.
2.15.2.1	Professional Archaeological Monitoring	Archaeology	Professional archaeological monitoring is required.
2.15.2.2	Monitor Duties	Archaeology	Archaeological monitoring requirements.
2.15.3	Site Protection and Employee Education	Archaeology	Employee archaeological training requirements.
2.16	Welding (Fire Prevention)	Welding	Welding requirements to prevent fire.
2.17.1	Seed Requirements	Seed Mixtures	Specifications for seed mixes for reclamation.
2.17.2	Seeding Methods	Seed Mixtures	Seeding methods for reclamation.
2.18	Waste Material and Fluids	Drilling	All waste material from drilling must be disposed of properly.

[1] Note that the measures listed in this table would be applied on a case-by-case basis, to be determined by BLM specialists depending on site-specific conditions. See **Appendix B** for more detailed descriptions.

2.5 Reasonably Foreseeable Future Actions

The activities and proposed projects listed in **Table 2-10** are reasonably foreseeable in the vicinity of the project area. Their impacts on the region will be considered in combination with the proposed HB In-Situ Solution Mine Project to determine the cumulative effects.

Table 2-10 Reasonably Foreseeable Future Actions

Project	Brief Description	Approximate Location
1. Intrepid water-saving improvements	Planned upgrades to Intrepid's East Mine langbeinite process plant, projected to be completed by the end of 2011, anticipated to decrease Caprock water usage by approximately 600 to 700 gpm.	Intrepid East Mill
2. Polyhalite mining project	Intercontinental Potash is considering a polyhalite mining operation on state and federal mineral leases and surface. The planned extraction method is underground room and pillar mining approximately 1,500 feet below the surface. Exploratory drilling is ongoing to evaluate the extent and quality of the potash formations.	In five townships in Lea County, New Mexico, approximately 9 miles from the eastern boundary of the SPA
3. BLM vegetation management	As part of the Restore New Mexico program, the BLM plans several chemical treatments to manage invasive plants (mesquite and creosote). No surface disturbance is planned.	Within and near project area
4. Construction and maintenance for recreation	There is a proposal to construct a new parking lot in the Hackberry SRMA, approximately 0.5 to 1 acre in size. Trail maintenance is ongoing and involves little, if any, surface disturbance.	Hackberry SRMA
5. Creamer water project	A private landowner is proposing to develop a well on state land to supply saline water for sale to the oil and gas industry. The water may be coming from the Rustler Formation. Also proposing a pipeline running north up a small dirt road, crossing under the highway and ending at an old caliche pit where storage tanks would be installed.	Section 2, T20S, R30E (southeast of Clayton Lake)
6. Oil and gas drilling and production	Oil and gas drilling of new wells and production from existing wells would continue in the SPA according to BLM policy and approval. It is anticipated that oil and gas drilling operations would continue at the current rate of 75 per year in the SPA and 1 per year within the project area. An average of 3.5 acres would be disturbed for each new well pad constructed.	In the SPA and project area

Table 2-10 Reasonably Foreseeable Future Actions

Project	Brief Description	Approximate Location
7. Derrick well	Intrepid recently converted an old core hole to a water supply well in the vicinity of the Rustler wells proposed for the project. The well extracts from the Rustler Formation, using the same source as the proposed new Rustler wells. Intrepid anticipates using this well at a rate of approximately 20 gpm to supplement processing water at the West Plant.	Section 1, T21S, R29E

2.6 Summary of Impacts

Table 2-11 provides a summary of the key environmental impacts for each resource analyzed. Detailed descriptions of impacts are presented for each alternative in Chapter 4.0. The summarized impacts assume the implementation of applicant-committed environmental protection measures and the BLM required environmental protection measures. However, it is not assumed that the recommended mitigation measures would be implemented. Implementation of the recommended mitigation measures identified in Chapter 4.0 potentially would further reduce impacts.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Geology and Minerals					
Subsidence Hazards	Natural and historical mine-related subsidence likely to continue.	Increased potential for mining-related subsidence as more potash is removed. Maximum subsidence is 0.6 foot.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed.
Caves	No impact other than from ongoing natural and historical mine-related subsidence that may affect caves.	New access roads may increase public access of caves. Small chance that drilling into unrecorded cave/karst features may allow fresh water to enter the groundwater system or dissolve evaporite strata. 42 to 43 known caves in the project area may be affected by drawdown.	New access roads may increase public access of caves. Small chance that drilling into unrecorded cave/karst features may allow fresh water to enter the groundwater system or dissolve evaporite strata. 18 to 38 known caves in the project area may be affected by drawdown.	Same as Proposed Action.	Same as Alternative B.
Minerals	No additional potash would be recovered from inactive workings and maximum recovery of the mineral resource would not be achieved. Intrepid's conventionally mined potash leases would not exceed 96,000 acres in New Mexico.	Additional potash reserves would be recovered and the maximum recovery of the mineral resource would be achieved. The total acreage of Intrepid's potash leases may increase.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Oil and Gas	There would be no change to oil and gas's existing access to fluid minerals in the project area.	Oil and gas access to fluid minerals in the project area would not be affected.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Paleontological Resources	Potential impacts are small.	Potential impacts are small, but may increase as public access to the area increases due to new roads.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Water					
Subwatersheds most affected by surface disturbance	None.	Clayton Basin and Maroon Cliffs.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Number of locations where surface pipelines block drainages, increasing potential erosion	None.	9	Same as Proposed Action.	0	6
Maximum Rustler area drawdown depth and acreage	No impact.	200 feet; 1,850 to 6,500 acres, depending on Rustler model used.	0 to 200 feet, depending on water source used. 200-foot drawdown contour encompasses between 1,450 and 4,750 acres, depending on Rustler model used.	Same as Proposed Action.	Same as Alternative B.
Maximum seep/spring reduction	No impact.	64%	31%	Same as Proposed Action.	Same as Alternative B.
Maximum Nash Draw flux reduction	No impact.	35%	25%	Same as Proposed Action.	Same as Alternative B.
Maximum Caprock area drawdown	No impact.	8 feet	52 feet	Same as Proposed Action.	Same as Alternative B.
Maximum Caprock area drawdown over life of project	No impact.	8 feet	34 feet	Same as Proposed Action.	Same as Alternative B.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Soils					
Low revegetation potential soils disturbed	None.	792 acres	Max. 1,145 acres (existing Caprock pipeline option)	Same as Proposed Action.	862 acres
High wind erosion soils disturbed	None.	216 acres	Max. 357 acres (existing Caprock pipeline option)	Same as Proposed Action.	284 acres
Air Quality					
New HB mill emissions	None.	No exceedance of ambient air quality standards or PSD increment. PM_{10}=11.8 tpy; NO_X=12 tpy; SO_2=0.07; VOC=0.7	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
State and federal ambient air quality standards	No impacts.	Not exceeded by fugitive or stationary sources. Total project NO_X emissions <0.001% of current Eddy County emissions.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Sensitive areas	No impacts.	Not affected by emissions from project.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Climate Change					
Greenhouse gas CO_2 equivalent emissions	None.	Negligible impacts to global climate change from construction and project operations.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Vegetation					
Vegetation types disturbed (acres)	None.	Mesquite Upland Scrub: 597 acres: Desert Scrub: 346 acres; Grassland: 44 acres.	Existing Caprock pipeline replacement: Mesquite Upland Scrub: 803 acres: Desert Scrub: 387 acres; Grassland: 154 acres. New Caprock Pipeline: Mesquite Upland Scrub: 736 acres: Desert Scrub: 377 acres; Grassland: 142 acres.	Same as Proposed Action.	New Caprock pipeline replacement: Mesquite Upland Scrub: 723 acres: Desert Scrub: 404 acres; Grassland: 142 acres.
Vegetation types most affected by groundwater drawdown (acres)	None.	Mesquite Upland Scrub: 5,932 – 6,044 acres: Desert Scrub: 2,561 – 2,622 acres; Grassland: 836 – 840 acres; Woody Riparian: 639 – 655 acres.	Mesquite Upland Scrub: 1,332 – 3,282 acres: Desert Scrub: 483 – 1,579 acres; Grassland: 738 – 425 acres; Woody Riparian: 6 – 56 acres.	Same as Proposed Action.	Same as Alternative B.
Sensitive plant species habitat potentially affected	None.	Scheer's beehive cactus: 377 acres; gypsum wild buckwheat: 128 acres.	Existing Caprock pipeline: Scheer's beehive cactus: 420 acres; gypsum wild buckwheat: 138 acres New Caprock pipeline: Scheer's beehive cactus: 420 acres; gypsum wild buckwheat: 138 acres	Same as Proposed Action.	New Caprock pipeline Scheer's beehive cactus: 443 acres; gypsum wild buckwheat: 135 acres

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Wildlife and Fish					
Terrestrial wildlife habitat	None.	Impacts from surface disturbance, habitat disruption, and fragmentation would be relatively minor. Less mobile small game and nongame species likely to be the most affected by surface disturbance and blockage of movements due to surface pipelines. Significant potential adverse impacts to migratory birds from exposure to evaporation pond water unless mitigation measures are implemented.	Same as Proposed Action.	Same as Proposed action with no wildlife movement blockages due since pipelines will be buried.	Same as Proposed Action with less wildlife movement blockages due to fewer and more strategically placed surface pipelines.
Sensitive Species	None.	The seven bat species, burrowing owl, loggerhead shrike, and sand dune lizard may be affected by changes to the scrub, grass, and woody riparian vegetation types due to surface disturbance or groundwater drawdown. Changes to grasslands would primarily affect the habitat of the swift fox, Baird's sparrow, lesser prairie-chicken, gray vireo, and Texas horned lizard. Impacts would be minor due to availability of similar cover types nearby.	Impacts similar to the Proposed Action, except that there is greater potential for adverse impacts to sand dune lizards and lesser prairie-chickens. However, these impacts would be minimized by implementation of the BLM's required environmental protection measures.	Same as Proposed Action.	Same as Alternative B; however, pipelines have been rerouted to avoid sand dune lizard habitat to avoid potential for adverse impacts.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Rangelands/ Livestock Grazing					
Animal unit months (AUMs) lost due to permanent facilities	No new disturbance.	125 AUMs lost; most (86) in Maroon Cliffs allotment. Most AUM reductions would occur on private land.	Existing Caprock pipeline option: 173 AUMs lost; most (88) in Maroon Cliffs allotment. New Caprock pipeline option: 152 AUMs lost; most (86) in Maroon Cliffs allotment Most AUM reductions would occur on private land.	Same as Proposed Action.	148 AUMs lost; most (88) in Maroon Cliffs allotment. Most AUM reductions would occur on private land.
Lands and Realty					
Effect on other land uses	None.	Temporary minor impacts on vehicle traffic in and near project area during construction; aboveground pipelines may affect land user travel and other land uses in the future.	Same as Proposed Action.	Temporary minor impacts on vehicle traffic in and near project area during construction.	Same as Proposed Action; however, 68% of the pipelines would be buried.
Recreation					
Effect on recreational uses	No additional disturbance.	5% of Hackberry SRMA acreage within potential subsidence area; increased public access by vehicles due to new roads; aboveground pipelines may obstruct OHV trails. Construction and operation activities may disrupt dispersed recreational users.	Same as Proposed Action.	5% of Hackberry SRMA acreage within potential subsidence area; increased public access by vehicles due to new roads. Construction and operation activities may disrupt dispersed recreational users.	Same as Proposed Action; however, 68% of the pipelines would be buried. All of the pipeline within Hackberry SRMA would be buried, resulting in fewer changes to OHV trails and access.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Visual Resources					
Viewshed modifications	No change.	Slight to moderate modifications of the viewshed by the addition of man-made features. In compliance with VRM Class IV management.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Cultural Resources					
Effect on archaeological sites	None.	Potential direct effects to National Register of Historic Places (NRHP)-eligible sites from construction would be avoided or mitigated through data recovery. Potential loss of ineligible sites. Increased public access may result in more illegal collecting.	Same as Proposed Action.	Same as Proposed Action	Same as Proposed Action.
Hazardous Materials, Health and Safety					
Emergency plans	Existing emergency response and spill plans.	Development of new emergency response and spills plans, new health and safety training for new employees.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Socioeconomics, Environmental Justice					
Total Employment (# of employees)	629 current existing employees at Intrepid facilities near the project area.	In addition to existing work force: Short-term (peak) : 274 Long-term: 36	In addition to existing employees: Short-term (peak): 285 Long-term: 36	Slightly higher than the Proposed Action, fewer than Alternative B.	In addition to existing work force: Short-term (peak) : 272 Long-term: 36
Indirect or Induced employment	N/A.	Short-term average: 194 Long-term: 19	Short-term average: 204 Long-term: 19	Slightly higher than the Proposed Action, fewer than Alternative B.	Same as the Proposed Action, but longer duration.

Table 2-11 Summary of Environmental Impacts

Resources Affected	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Population changes	None.	+Short term: Up to 221 for construction Long term: +24 for operations.	+Short term: Up to 233 for construction Long term +24 for operations.	Same as Alternative B	Same as Proposed Action.
Housing demands	None.	Short term: Peak of 140 units, mostly motel rooms, RV camp sites and apartments in Carlsbad Long term: 10 units	Short term peak of 147 units, primarily in Carlsbad Long term10 units	Slightly higher than the Proposed Action, fewer than Alternative B.	Same as Proposed Action.
Federal mineral royalties, annual	No change.	Between $2.3 million and $4.7 million in addition to existing for potash production.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Local property taxes, annual	No change.	Between $0.53 million and $1.05 million annually.	Slightly higher than Proposed Action due to higher capital investment.	Same as Alternative B.	Same as Alternative B.
Gross receipts, personal and corporate income taxes; life of project	No change	As much as $9.8 million in addition to those from existing operations	Slightly higher than the Proposed Action	Slightly higher than the Proposed Action, lower than Alternative B.	Same as Alternative B
Environmental justice	No disproportionate adverse effects on minority or low-income populations.	Same as No Action.	Same as No Action.	Same as No Action.	Same as No Action.

3.0 Description of the Affected Environment

3.1 Introduction

This chapter describes the environment that would be affected by the development of the Proposed Action and the alternatives analyzed in this EIS. The baseline information summarized in this chapter was obtained from published and unpublished materials; interviews with local, state, and federal agencies; and from field and laboratory studies conducted in the project area. The affected environment for individual resources was delineated based on the area of potential direct and indirect environmental impacts for the proposed project.

In general, the descriptions of the affected environment focus on the land within the project area boundary shown in **Figure 1-1**. For resources such as soils and vegetation, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the proposed project. For other resources such as water, air quality, and social and economic values, the description of the affected environment is more extensive (e.g., watersheds, regional geology, climate, local communities, etc.).

The specific aspects of each resource that are described in each section were selected because they have the potential to be affected by the proposed HB In-Situ Solution Mine Project or to affect the construction and operation of the proposed project.

3.2 Geology and Minerals

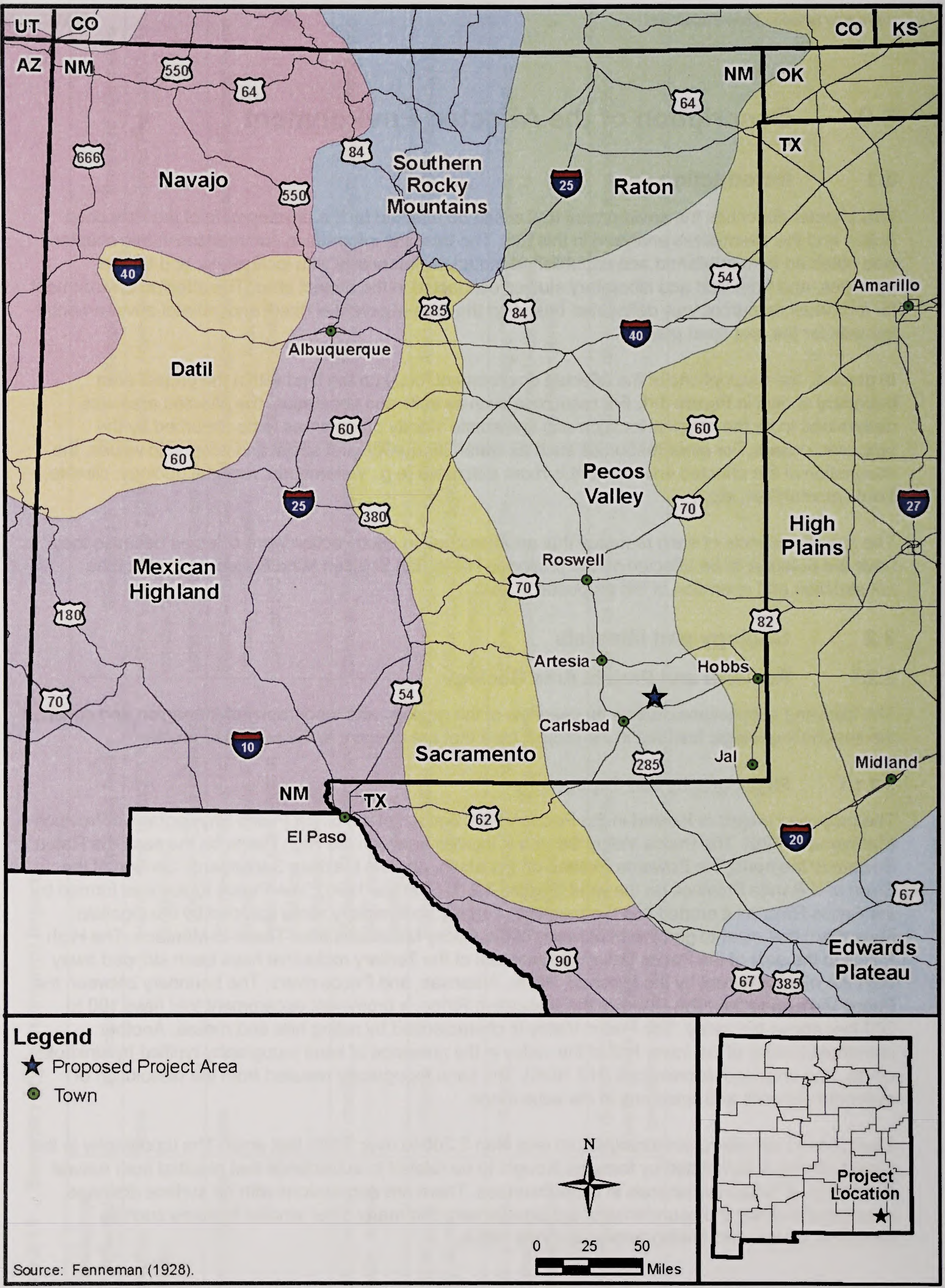
3.2.1 Regional and Project Area Geology

The following subsections provide an overview of the geology and topography of the region and describe the important geologic features in the project area that are relevant to the proposed project.

3.2.1.1 Physiography and Topography

The proposed project is located in the Pecos Valley Section of the Great Plains Physiographic Province (Fenneman 1928). The Pecos Valley Section is located between the High Plains on the east, the Raton Section to the north, the Edwards Plateau on the south, and the Mexican Sacramento Section of the Basin and Range Province on the west (**Figure 3.2-1**) (Trimble 1990). The Pecos Valley was formed by the Pecos River as it eroded into the mantle of Tertiary sedimentary rocks (capped by the Ogallala Formation) that used to gird the front range of the Rocky Mountains from Texas to Montana. The High Plains to the east of the Pecos Valley is a remnant of the Tertiary rocks that have been stripped away from the mountain front by the Missouri, Platte, Arkansas, and Pecos rivers. The boundary between the Pecos Valley and the High Plains is the Mescalero Ridge, a prominent escarpment that rises 100 to 200 feet above the valley. The Pecos Valley is characterized by rolling hills and mesas. Another prominent feature of the lower half of the valley is the presence of karst topography typified by sinkholes, caves, and enclosed depressions (Hill 1996). The karst topography resulted from the dissolution of evaporite deposits and limestone in the subsurface.

Elevations in the project area range from less than 3,200 to over 3,500 feet amsl. The topography in the project vicinity is dominated by features thought to be related to subsidence that resulted from natural dissolution of evaporite minerals in the subsurface. There are depressions with no surface drainage, escarpments along the boundaries of subsided areas, and many other smaller features such as sinkholes, caves, and sinking drainages (Vine 1963).



Source: Fenneman (1928).

Figure 3.2-1. Physiographic Provinces of New Mexico

3.2.1.2 Regional Geology

The proposed project is located in the Delaware Basin, a sub-basin of the greater Permian Basin of west Texas and New Mexico (see **Figure 3.2-2**). The Delaware Basin is bounded on four sides by basement uplifts that include the Marathon Fold Belt to the south, the Diablo Platform on the west, the Northwest Shelf to the north, and the Central Platform to the east (Montgomery et al. 1999). The sedimentary rocks in the basin dip gently to the south and east and the deepest part of the basin is on the southeast side in Pecos County, Texas. There are complex bounding fault zones on the east, south, and west sides of the basin. Along the structural boundary along the Northwest Shelf to the north, there are no faults as rocks dip gently to the south from the shelf into the basin (Hill 1996). Internally in the basin, the structure becomes more complex at depth with relatively little faulting and folding of the thick Permian section. Fold structures are common in areas of bedded salt such as in the SPA, but large complex structures are present in the deeper parts of the basin.

The Delaware Basin contains up to 30,000 feet of sedimentary rock with deposits ranging in age from Cambrian to Quaternary (Hill 1996; Roche 1997). The Precambrian basement consists mainly of granitic and metamorphic sedimentary rocks, but volcanic rocks also may be present. The Paleozoic section from Cambrian to Pennsylvanian consists of clastic and carbonate rocks deposited in a variety of environments including continental, shallow marine, shelf, and basin. The pre-Permian rocks are largely known from the drilling of the deeper oil and gas wells, but there are limited surface outcrops.

3.2.1.3 Project Area Geology

The important units in the project area consist of Permian rocks of the Guadalupian and Ochoan Series, which are described below. The units are categorized by their locations relative to the Capitan Reef, which marks the transition from shelf (back reef) to reef (basin margin) to basin.

The stratigraphic relationships are shown in **Figure 3.2-3** and a correlation diagram is shown in **Table 3.2-1**. The project area lies along the basin margin-reef area, defined by the Capitan Limestone.

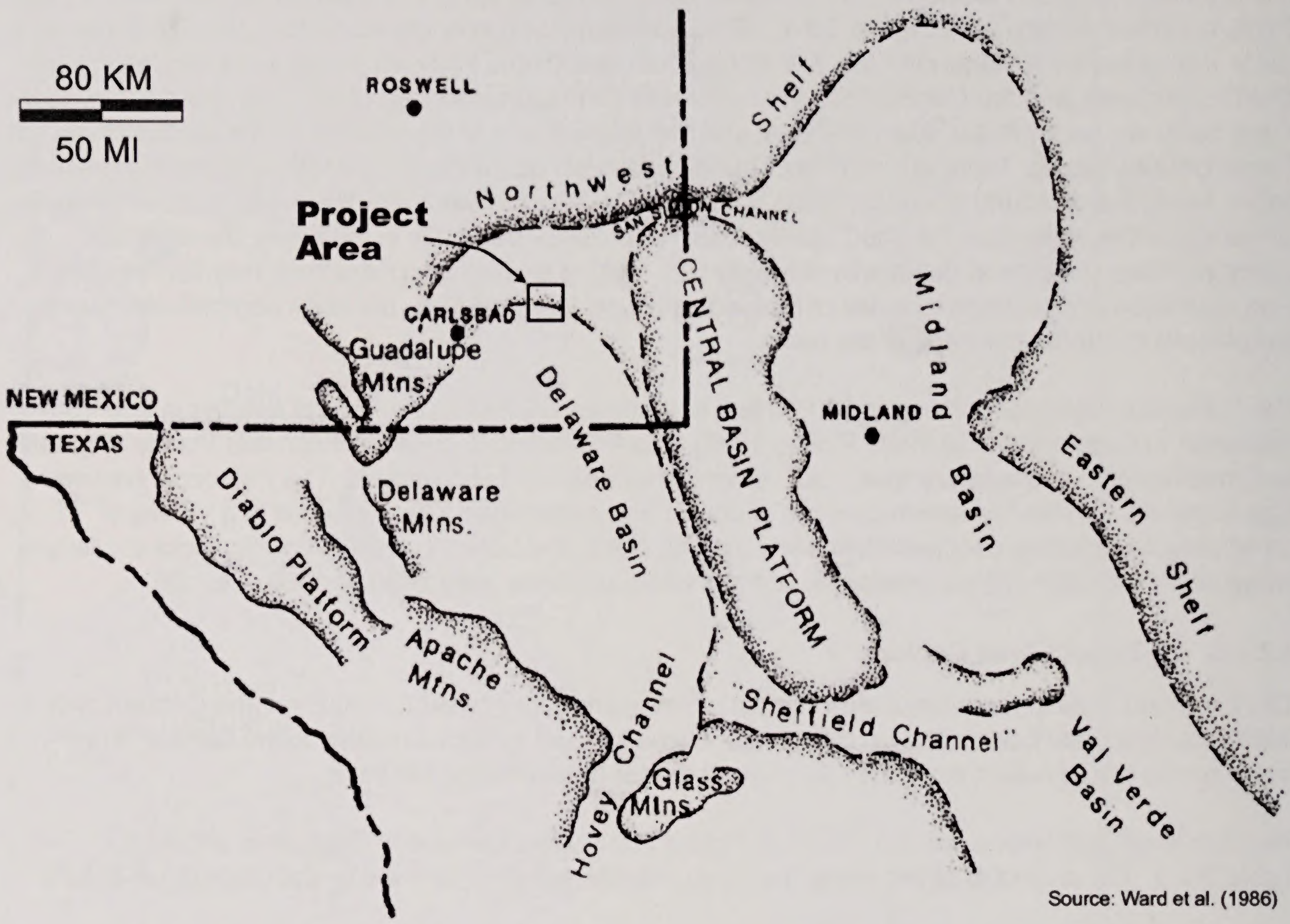
In addition to the upper Permian rocks, there are surficial exposures of Triassic, Tertiary, and Quaternary deposits in the project area that also are described below.

Permian Rocks

Guadalupian Series. Rock units in the Guadalupian Series of interest in the project area consist of the Capitan Limestone, Bell Canyon Formation, and the upper Artesia Group. These units are time-equivalent: the Capitan Limestone is the basin margin reef-derived unit, the Bell Canyon Formation was deposited in the basin, and the upper Artesia Group consists of back reef and shelf deposits.

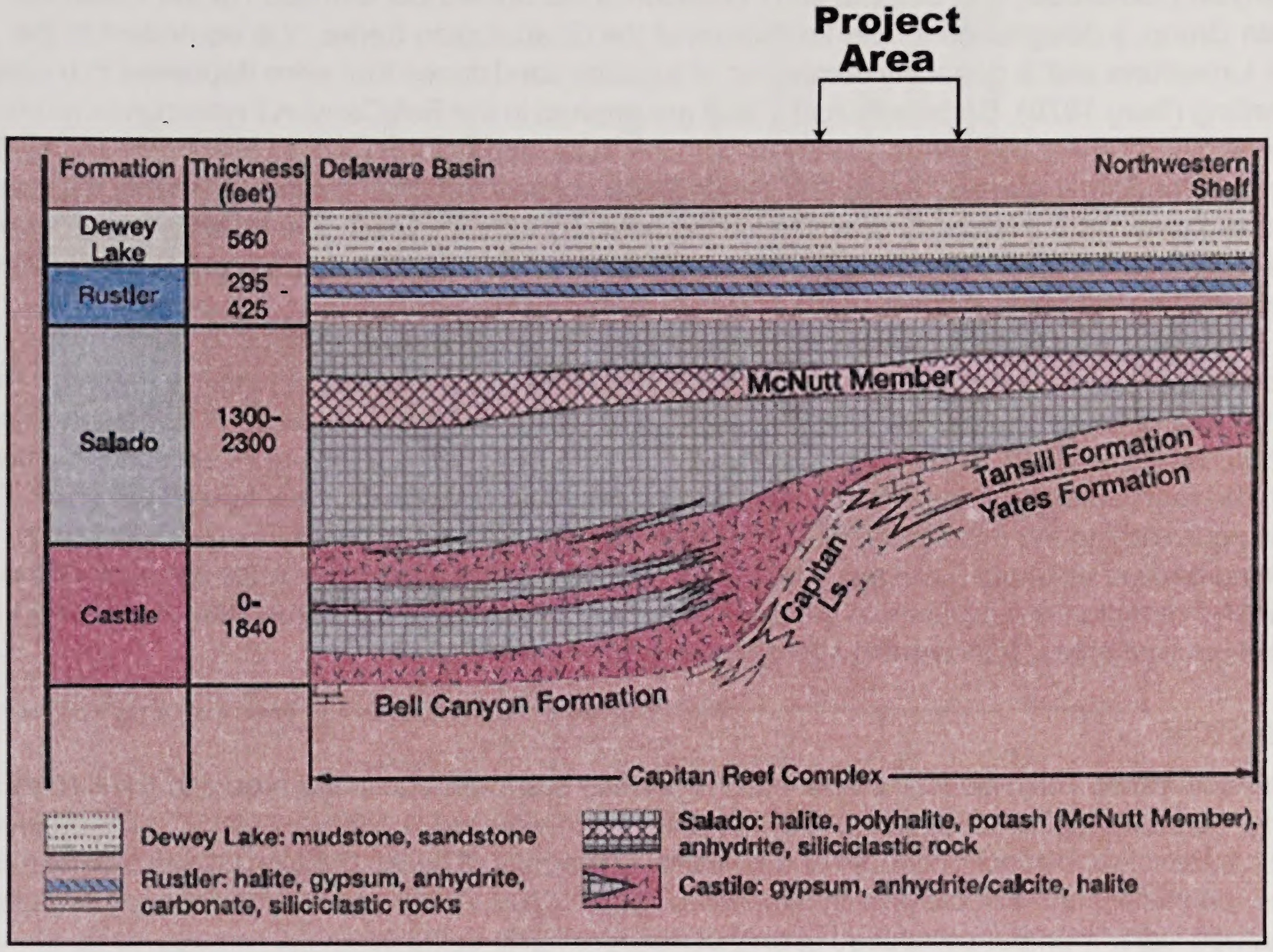
Capitan Limestone. At the beginning of the Permian period, the configuration of the present Delaware Basin began to take shape (Hayes 1964). In late Guadalupian time, conditions were favorable for reef growth at the basin margin so the Capitan Limestone reef deposits built upward and toward the basin.

The Capitan Limestone is composed of massive reef material and associated reef talus zones (Hayes 1964). The reef material is thought to have been derived from organisms such as algae and sponges. Diagenetic changes and recrystallization have obscured most of the fossils. The massive reef-building rock built upward and toward the basin and developed on top of its own talus deposits. The talus resulted from erosion of the reef material at the water surface to wave base. Porosity in the massive Capitan reef facies is generally low because of cements, but there are occasional vugs and cavernous porosity (Hill 1996).



Source: Ward et al. (1986)

Figure 3.2-2 Major Structural Elements in the Region



Source: Barker et. at (2008)

Figure 3.2-3 Stratigraphic Relationship between Upper Guadalupian-Ochoan Series

Table 3.2-1 Upper Guadalupian-Ochoan Formations in Project Area

		South	Project Area	North	
		Delaware Basin		Northwest Shelf	
System	**Series**	**Basin**	**Basin Margin - Reef**	**Shelf - Back Reef**	**Approximate Thickness in Project Area (feet)**
Permian	Ochoan	Dewey Lake Red Beds	Dewey Lake Red Beds	Dewey Lake Red Beds	Up to 250
		Rustler Formation	Rustler Formation	Rustler Formation	Up to 350
		Salado Formation	Salado Formation	Salado Formation	150 to 1,000
		Castile Formation	Castile Formation	No equivalent	10 to 80
	Guadalupian	Bell Canyon Formation	Capitan Limestone	Tansill Formation	1,500
				Yates Formation	
				Seven Rivers	

Sources: Hayes 1964; Hill 1996; Lambert 1983; New Mexico Oil Conservation Division (OCD) 2009a; Wills 1942.

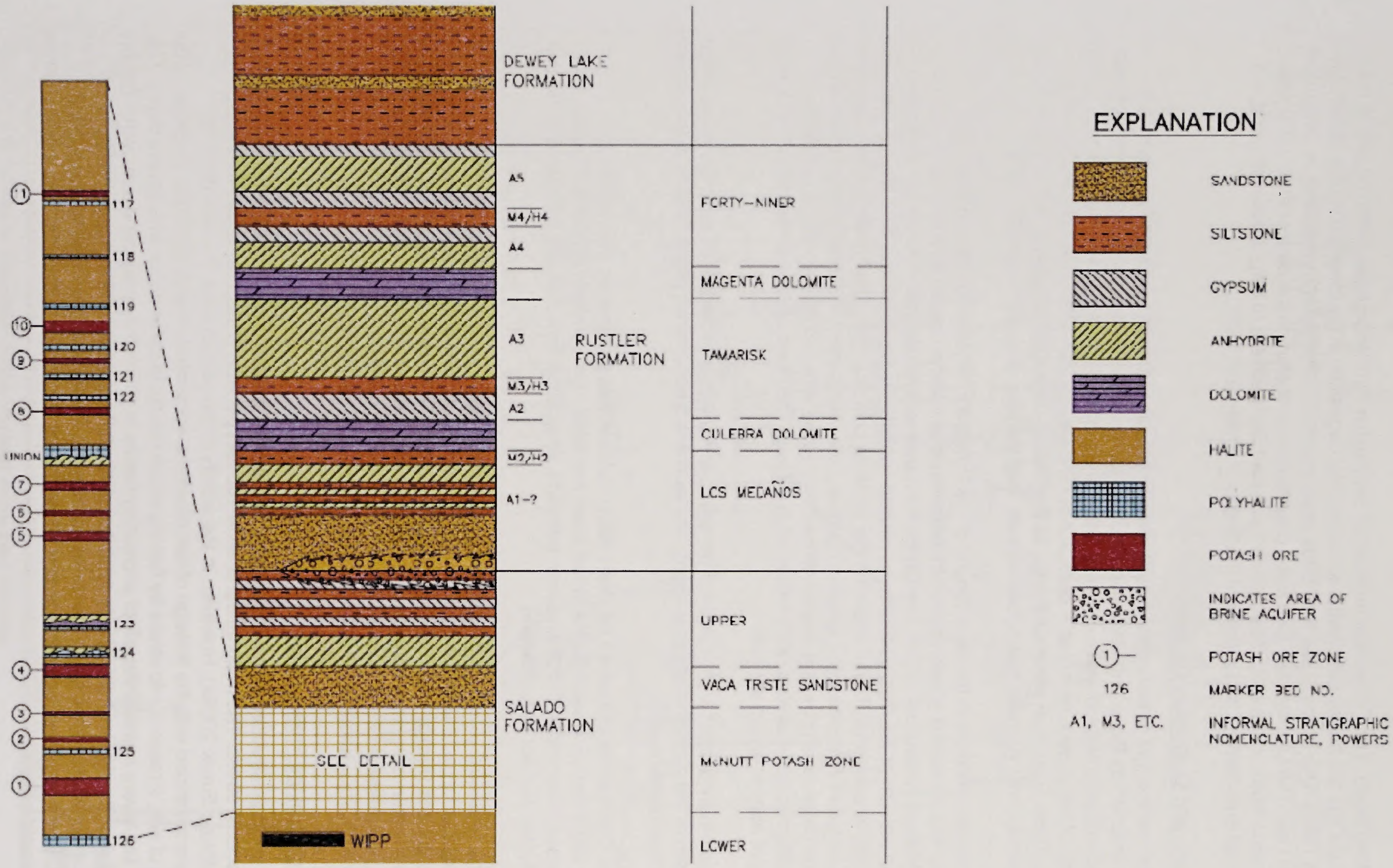
Bell Canyon Formation. The Bell Canyon Formation is the uppermost formation of the Delaware Mountain Group, a designation for the formations of the Guadalupian Series. It is equivalent to the Capitan Limestone and is generally composed of turbidite sandstones that were deposited in a deep water setting (Berg 1979). Carbonate rocks also are present in the Bell Canyon Formation in areas close to the reef. Bell Canyon sediments interfinger with the talus slope of the Capitan Reef. The Delaware Basin was a “sediment-starved” basin, but during times of sea level drop, clastic sediments were moved to the shelf margin and eventually deposited in the basin by turbidity flows. The turbidity flows deposited sand in elongated sinuous channels with sediment transport from north to south and southwest across the shelf and into the basin (Payne 1976).

Artesia Group. The formations in the upper part of the Artesia Group, Tansill, Yates, and Seven Rivers, are composed of rocks that are the time-equivalent units to the Capitan Limestone. The Seven Rivers Formation, time-equivalent to the lower Capitan Limestone, is largely composed of dolomite in areas close to the reef. Dolomite transitions into gypsum or anhydrite (carbonate) rock toward the shelf. The Yates is equivalent to the middle Capitan Limestone, consisting of up to two-thirds sandstone with intervening beds of dolomite (Lambert 1983). The Yates grades to evaporites in the direction of the shelf. The Tansill Formation is equivalent to the upper Capitan Limestone and is composed of dolomite in the basin margin-reef areas, transitioning into evaporites towards the shelf.

Ochoan Series

Salado Formation. The Salado Formation is the primary salt formation in the area and the formation mined for potash. The Salado is over 2,000 feet thick regionally, but is 1,000 feet thick in the project area. It contains four distinct members and is mainly composed of halite, but also contains anhydrite, siltstone, polyhalite, and soluble potash minerals (**Figure 3.2-4**). At the base of the Salado Formation is an unnamed lower member composed mainly of massive halite in the basin that also contains an anhydrite bed used to mark the base of the Salado in areas over the reef (Hill1996). This lower member is used as the repository host at the Waste Isolation Pilot Plant (WIPP) facility southeast of the project area. Overlying the lower member is the McNutt Potash Member, which contains the potash ore zones. The Vaca Triste Sandstone overlies the McNutt Potash Member and, while only ten feet thick, is a highly recognizable and widespread marker bed (Hill 1996). The upper member of the Salado, also unnamed, consists of halite, siltstone, and anhydrite. At the top of the upper member is a 30-foot-thick zone composed of unconsolidated clay that is thought to be the breccia zone caused by the dissolution of halite.

Rustler Formation. The Rustler Formation continues the succession of Ochoan units, and is present on the surface as well as in the subsurface in the project area. It is composed of anhydrite, dolomite, siltstone, sandstone, and gypsum. Members of the Rustler Formation from bottom to top are the Los Medaños, Culebra Dolomite, Tamarisk, Magenta Dolomite, and the Forty-niner (**Figure 3.2-4**). The Los Medaños member is composed of siltstone, gypsum, and fine-grained sandstone. The Culebra Dolomite is a thin-bedded crystalline dolomite that also has vugular porosity (Hill 1996). It is resistive to weathering and forms prominent outcrops where exposed. The Culebra Dolomite is exposed south of the project area at the southern end of Nash Draw. Above the Culebra, the Tamarisk member is largely composed of massive anhydrite that weathers to gypsum in outcrops. It also contains minor amounts of halite and siltstone. The next member is the Magenta Dolomite, which is 20 to 30 feet thick and identified by its color. When it weathers, it varies from pink to red to purple (Hill 1996). The uppermost member, the Forty-niner, is composed of gypsum, anhydrite, siltstone, shale, and clay.



Source: Intrepid Potash/Shaw (2008a)

Figure 3.2-4. Stratigraphic Column in the Project Area

Dewey Lake Red Beds. The Forty-niner member of the Rustler Formation represents the end of the marine incursions into the basin; the change to continental deposition is represented by the Dewey Lake Red Beds (Hill 1996). The Dewey Lake Red Beds are composed of reddish-orange siltstone with minor sandstone and clay. The Dewey Lake Red Beds are present as outliers in the project area, but more extensive outcrops occur to the east. The Dewey Lake Red Beds appear to have been deposited in a low-energy fluvial environment and represent the end of Permian (Hill 1996).

Triassic, Tertiary, and Quaternary Deposits

Triassic-aged rocks thought to be Santa Rosa Formation are present in the project area. Undivided Triassic rocks mapped by Dane and Bachman (1958) in the project area are composed of maroon, red, and gray sandstone interbedded with red, sandy shale and purplish limestone. The Santa Rosa outcrops on the east side of the project area (see **Figure 3.2-5**). The Dewey Lake Red Beds are distinguished from the Santa Rosa Formation because the top of the Dewey Lake is an erosion surface. The erosion surface is in contact with younger rocks, making it an “angular unconformity" (Lambert 1983).

Tertiary sedimentary deposits in the area consist of the Ogallala Formation that is composed of sandstone, silt, and cemented gravel capped by discontinuous caliche layers (New Mexico Bureau of Geology and Mineral Resources 2003). The Ogallala Formation was deposited during the Oligocene when uplift and erosion of the Rocky Mountains caused sediment to be deposited over a large area east of the mountains. In addition to fluvial deposits, the Ogallala contains considerable wind-blown deposits. Tertiary rocks include Oligocene-aged igneous dikes and sills are present in the project area (Calzia and Hiss 1978). The dikes reported in the potash mines occur as parallel and nearly vertical intrusions of trachyte (light-colored igneous rock) with widths up to 12 feet. The dikes appear to die out in the Ochoan rocks and do not appear on the surface.

The oldest Quaternary deposit is the Gatuña Formation, which is present in limited outcrops in the Nash Draw area south of the project area (Vine 1963). The extent and occurrence of the Gatuña in the project area has not been determined.

The Mescalero Caliche was described by Vine (1963) as limestone that ranges from dense to travertine-like with intermixed sand grains. It has been mapped in the southern part of the project area near the proposed evaporation ponds and near Intrepid’s West Mine; however, the full extent of the unit over the entire area has not been mapped.

Recent geologic materials at or near the surface in the project area consist of layers of alluvium, windblown sand, and gypsite that cover most of the Permian rocks (Wills 1942). Where deep channels have been cut into the Permian bedrock, recent materials may be as thick as 500 feet. Windblown deposits are fairly extensive over the project area. Playa deposits are mapped at the south end of Nash Draw at Salt Lake (Laguna Grande de la Sal), but not in the project area (Intrepid Potash Inc./Shaw 2008a; Vine 1963). The largest playa in this area is Salt Lake, south of Nash Draw.

Geologic Structure of the Project Area

The localized geologic structure of the project area was formed predominantly by salt dissolution and flowage not tectonic stress. The regional dip is 90 to 100 feet per mile (1 degree) to the southeast (Intrepid/Potash Inc./Shaw 2008a). However, in the vicinity of the project area, the dissolution of evaporite layers combined with the flowage of salt created a somewhat chaotic structure. Because of the plastic nature of salt, it responds to stress by flowing which results in deformation of adjacent strata. The dissolution of salt layers has had the effect of creating basins in which the strata bend downward into the depression against the regional dip. This is exhibited at Nash Draw where the structure on top of the Salado forms a closed depression and the rocks exposed on the surface have a chaotic, jumbled appearance. Other evidence of salt flowage and dissolution in the project vicinity includes localized steep dips and salt-cored anticlines.

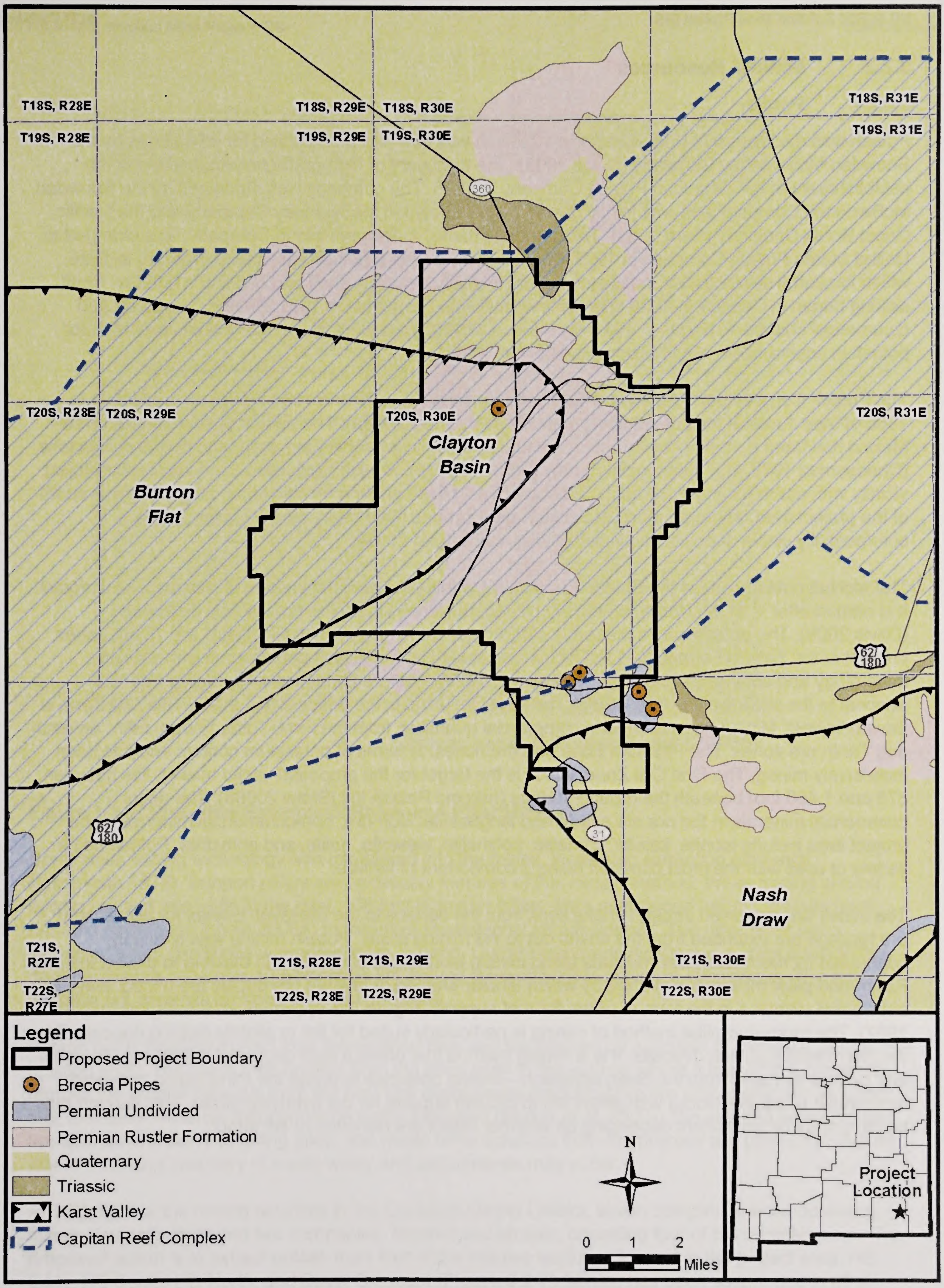


Figure 3.2-5. Surficial Geology of the Project Area and Vicinity

3.2.2 Mineral Resources

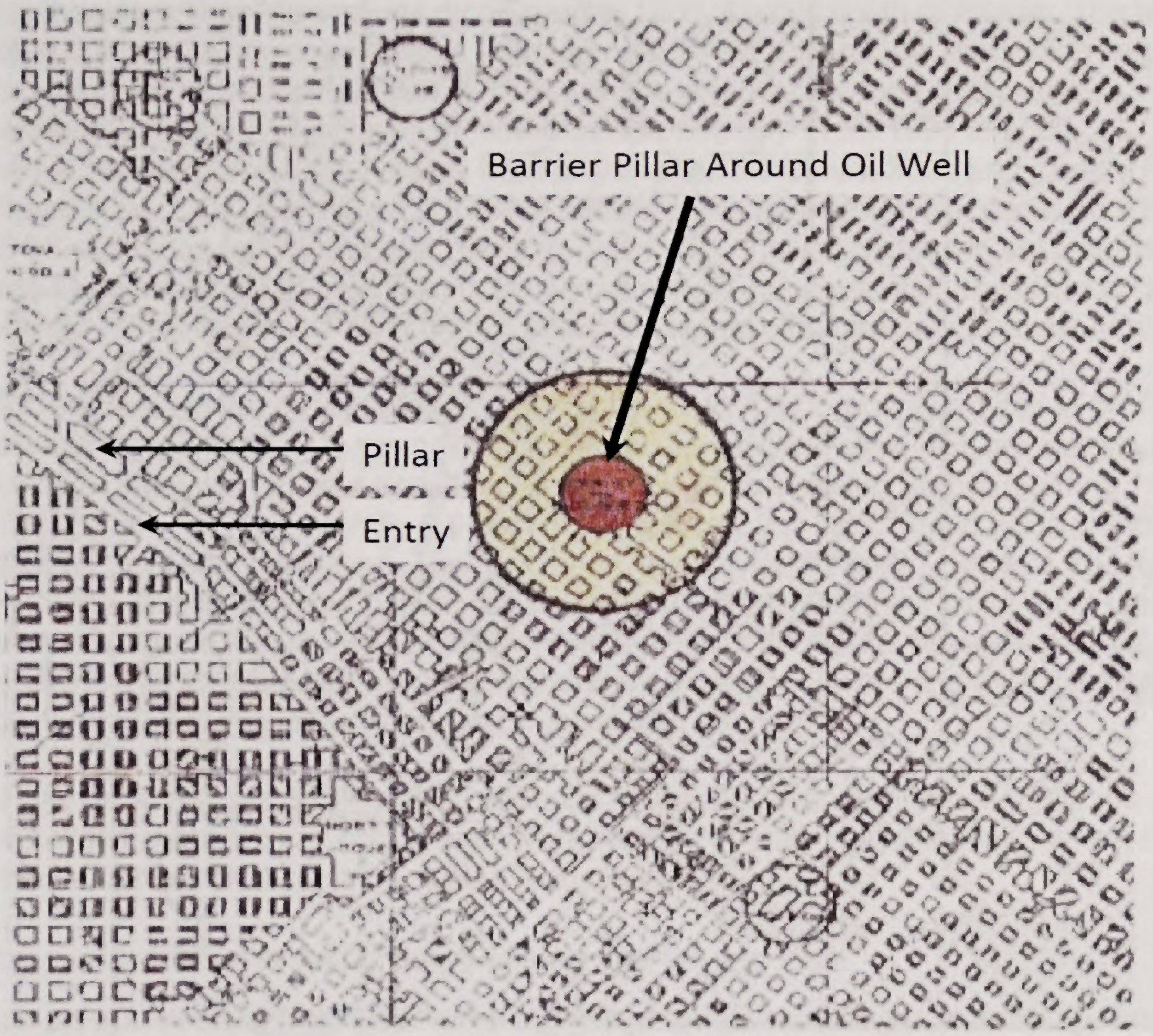
3.2.2.1 Potash

Potash was discovered in Eddy County in 1925 in a well that was being drilled for oil and gas by the Snowden McSweeney Company (Davis 2009). The discovery of high-grade potash resulted in the establishment of the American Potash Company in 1926. The company was organized by the Snowden McSweeney Company and was jointly owned by the Snowden McSweeney Company and the Pacific Coast Borax Company (Kern 1984). The company name, American Potash Company, was changed to United States Potash Company in 1929. The company began a potash exploration program in 1926, which located a sylvite bed of sufficient quantity to justify sinking a shaft and building a refinery. Shaft sinking began in December 1929 and the first shaft was completed in 1931. Potash production and commercial shipments began in 1931. By the mid-1930s, there were eleven companies exploring for potash in southeastern New Mexico (Barker et al. 2008).

The Potash Corporation of America (PCA) began mining operations in 1934 with peak production in 1966 of over 1 million tons of potash (Intrepid Potash/Shaw 2008a). The potash in southeastern New Mexico has been a major potash resource and the remaining reserves are estimated at 500 million tons (Cheeseman 1978, U.S. Geological Survey [USGS] 2009a). Potash production continues in the project vicinity with active mining at Intrepid's West and East Mines and the Mosaic Mine, about 10 miles south of the project area. Although much of the high-grade zones have been mined, exploration for commercially viable deposits continues (Muller and Galyen 2009).

The McNutt potash zone in the Salado Formation contains the potash minerals of interest to this project. It is named after V. H. McNutt who held the oil and gas lease where the potash was discovered (Davis 2009). The potash zones present a complicated mineralogy of potash. There are 12 ore zones present in the Salado Formation, 11 of which are located in the McNutt potash zone with varying mineralogy and commercial viability (Cheeseman 1978). The ore zones were numbered from the deepest to the shallowest by the USGS. The First Ore Zone is the deepest and the Twelfth Ore Zone is the shallowest. Mining has occurred in commercial quantities from the First, Third, Fourth, Fifth, Seventh, and Tenth ore zones. The First Ore Zone was the richest in terms of potassium content and has been extensively mined. The First Ore Zone, which is the target for the proposed in-situ mining, lies between 675 and 1,450 feet beneath the ground surface (Intrepid Potash Inc./Shaw 2008a). The major commercial minerals in the ore are sylvite and langbeinite. Non-ore, non-commercial minerals in the project area include leonite, kainite, carnalite, polyhalite, kieserite, halite, and anhydrite. Potash has a variety of uses with the most common being a component of fertilizer.

The mines are accessed through shafts sunk from the surface to the ore level. Entries for access and ore haulage are extended from the shafts out to the mining areas. Potash mining was originally conducted by room-and-pillar methods using mining techniques of drilling and blasting to extract the ore. Room-and-pillar mining is a method by which tabular-shaped or layered ore bodies are mined, leaving substantial reserves in the form of pillars for roof support (**Figure 3.2-6**) (American Geological Institute 1997). The room-and-pillar method of mining is particularly suited for flat or slightly dipping deposits like the New Mexico potash deposits. It is a mining method that offers a high degree of operational flexibility and derives its name from the basic approach—driving openings to divide the mineralized zone into rectangular or square blocks with pillars left to provide support for the overlying strata. This support may be temporary or permanent depending on whether pillars are removed or left intact.



Source: Intrepid Potash/Shaw (2008b)

Figure 3.2-6 Plan View Example of Room-and-Pillar Mining

Continuous mining technology was introduced into the mines, increasing extraction efficiency (Sisselman 1978). Support pillars are necessary features of this mining method. When mining around existing oil and gas wells in the past, 100-foot-diameter pillars were established around the well bore (Intrepid Potash Inc./Shaw 2008a) to minimize the potential for subsidence. The pillar sizes were increased when conditions warranted more support. Current standards dictate that a zone equal to the depth of the ore zone plus 10 percent be left around the well bore to minimize subsidence. The size of the pillar left depends on specific mine conditions.

Potash ore is typically moved from the working face and transported by a system of conveyor belts to the hoisting shaft. The ore is then hoisted from the mine level to the surface where it is sent to a refinery to remove the potash minerals from the ore. The major waste products from ore processing are sediment, salt, and other minerals that cannot be easily extracted (Barker et al. 2008). The salt and sediment are transported in a slurry to tailing piles, and waste brine solutions from the process are placed into ponds where additional recovery of waste water and salt minerals may occur.

At the height of the mining activities in the Carlsbad Mining District, seven companies were operating mines. Currently there are two companies, Intrepid and Mosaic, operating four of the original mines. The proposed action is to extract potash from four of the inactive workings located in the project area, HB Eddy, HB South, HB North, and Duval Crescent (**Figure 3.2-7**). Mining has been suspended in all of these areas, but potentially extractable resources remain in the support pillars, walls, and floors.

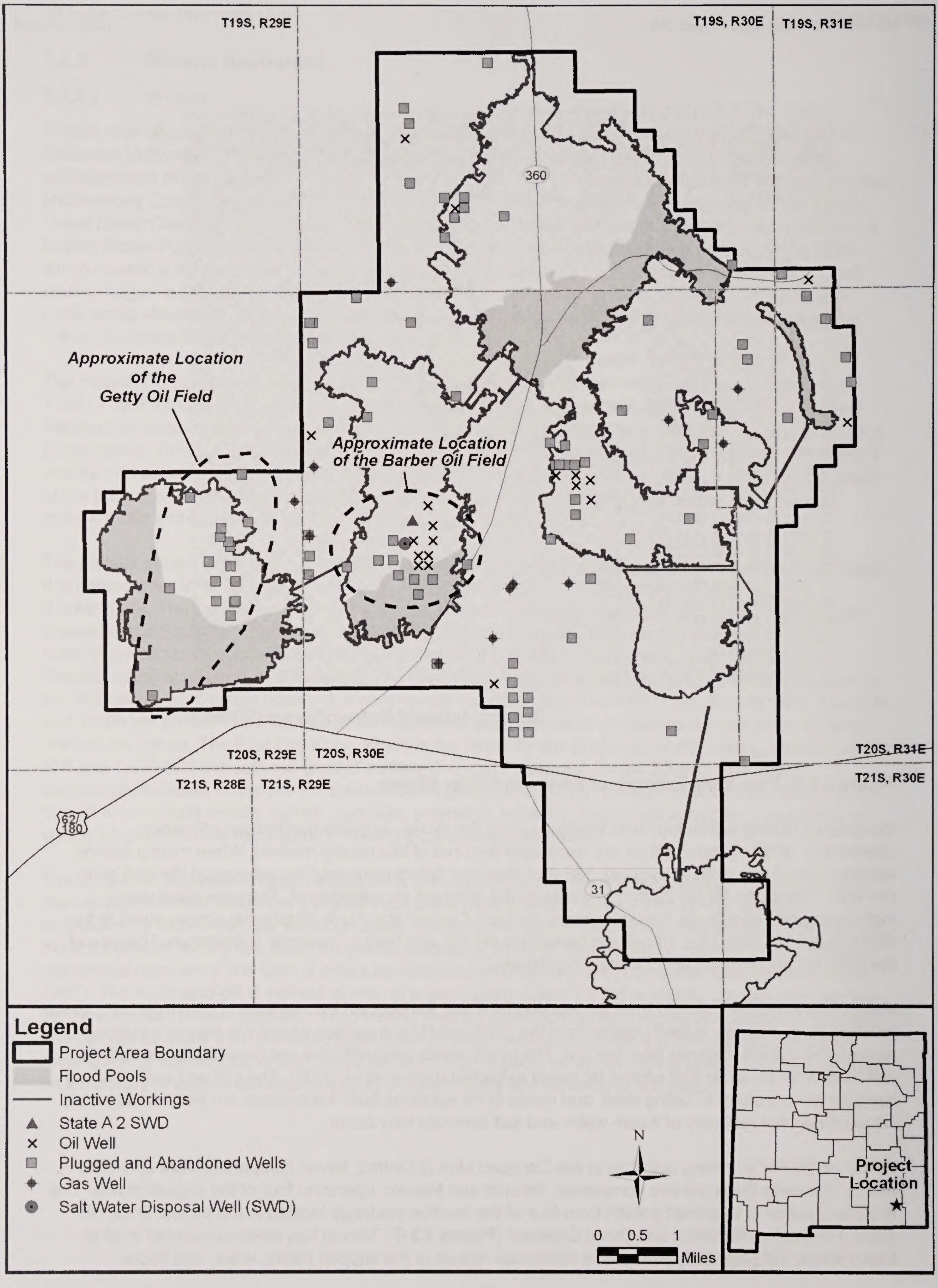


Figure 3.2-7. Oil and Gas Wells in Project Area

3.2.2.2 Oil and Gas Production

Oil in southeastern New Mexico was discovered in 1909, 8 miles south of Artesia. The well was never completed due to mechanical problems (Montgomery 1965). Oil and gas production began in the New Mexico portion of the Delaware Basin in 1924 with the discovery of the Dayton-Artesia Field (Independent Petroleum Association of New Mexico Undated). From 1924 to 2000, 300 reservoirs have produced 4.5 billion barrels of oil mainly from plays on the Northwest Shelf and Central Platform (Broadhead et al. 2004). More than 3.5 billion barrels of the total production came from Permian rocks. The USGS estimates that the greater Permian Basin area, including areas in southeastern New Mexico and west Texas, contains substantial undiscovered oil and gas resources. Evidence suggests that there is potentially 1.3 billion barrels of oil and 41 trillion cubic feet of natural gas (Schenk et al. 2008).

Oil was discovered in the project area in 1927 by the Getty Oil Company in Section 14, T20S, R29E (Wills 1942) (**Figure 3.2-7**). On the basis of the discovery of the Getty Field, several small oilfields were established along a west to east trend line. These new fields included Barber (starting 1937), PCA (1939), Hale (1940), and Wills (1942). Hale is the only gas field. These fields produced out of the limestones in the Yates Formation. The pay zones range in depth from 1,300 to 1,800 feet deep and are 300 to 400 feet deeper than the potash ore zones. Another oil field in the vicinity, the Dos Hermanos Field, was discovered in 1955 and produces from the Yates Formation (Broadhead et al. 2004). The Getty and Dos Hermanos fields have been abandoned and the Barber and PCA fields continue to produce, but many of the wells have been plugged and abandoned.

Oil and gas exploration and production continues in the project area, but the targets are much deeper and natural gas is the primary objective (Walsh 2006). There are scattered wells within the project area that produce from zones below the upper Guadalupian rocks.

3.2.2.3 Conflicts between Potash Mining and Oil and Gas

Although potash was originally discovered by wells drilled for oil and gas, conflicts between the oil and gas industry and potash mining emerged early on. The federal government withdrew 2,560 acres from oil and gas leasing for the purpose of protecting and conserving the potash deposits belonging to the United States (1939 Order). The 1939 withdrawal remained in effect until 1951, at which time the Secretary of the Interior issued a new Order that allowed for concurrent operations in the exploration, development, and production of oil and gas and potash owned by the U.S.A. A succession of orders followed (1951, 1965, 1975, and 1986), which expanded the SPA each time.

In 1986, the Secretary of the Interior issued the most recent Potash Order (Department of the Interior 1986), which expanded the area to 497,002 acres. The SPA boundaries are shown in **Figure 1-1**.

In addition to the 1986 Order, the State of New Mexico issued rules for oil and gas drilling in the Known Potash Leasing Area, which is a subset of the SPA. Since 1955, the New Mexico Oil Conservation Commission (OCC) issued a series of orders that have been amended over the years to specifically address how oil and gas operations are to be conducted in the potash enclave. The original OCC order was R-111-A and the current order is R-111-P. The most recent order issued in 1988, contains revisions meant to resolve disputes between the potash and oil and gas industries and clarify uncertainties regarding boundary changes (OCC 1988).

In 2004, the oil and gas production from the SPA was 27.3 billion cubic feet of gas and 4.7 million barrels of oil (Walsh 2006). The remaining oil and gas resource in the Potash Area is estimated to be 468 million barrels of oil and 5.5 trillion cubic feet of gas. A total of 1,291 wells have been drilled in the R-111-P area (Balch et al. 2009). Copies of the 1986 Order and the OCC Order R-111-P are provided in **Appendix A**.

3.2.2.4 Other Minerals

Other minerals produced in Eddy County include sand and gravel, caliche, salt, and sulfur (USGS 2009a). Salt is extracted in the area by the following two methods.

- Solution mining where a well is drilled into the salt formation and unsaturated water is pumped into the well to dissolve the salt. The saturated solution is extracted and used as make-up water for saturated drilling fluids for oil and gas well drilling. There are no brine extraction wells in the project area.
- Mining salt that has precipitated in playas is typically accomplished with the use of scrapers.

3.2.3 Geologic Hazards

3.2.3.1 Subsidence

Subsidence is defined as “a gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials” (Galloway et al. 2008). Subsidence can occur from several conditions including dissolution of subsurface strata, underground mining, withdrawal of subsurface fluids, drainage of organic soils, hydrocompaction, thawing permafrost, and natural consolidation.

Subsidence in the Delaware Basin has been caused primarily by the dissolution of subsurface strata or potash mining. Dissolution of subsurface strata is the result of natural conditions as well as the deliberate or inadvertent actions by humans. The mining of potash has caused some ground subsidence in the region.

Caves and Karst

Karst topography is widespread in the Delaware Basin. Karst is a terrain with distinctive, often rolling, landforms created from the dissolution of soluble rocks, principally limestone, gypsum, and dolomite. It is characterized by springs, caves, and sinkholes that are often directly connected to aquifers, causing them to be vulnerable to contamination by activities at or near the ground surface. The karst topography in this region is linked with sulfuric acid cave genesis, which causes rapid “bottom-up” cave formation, resulting in large karst features that may not be recognized from the surface (Hill 2000). Other karst features can result from anhydrite that expands in size when it becomes hydrated and turns to gypsum. The expansion can result in buckling and deformation of adjacent rock layers and cracking in the gypsum bed (Bachman 1983). The cracking and deformation of adjacent beds can allow fluids to infiltrate into lower rock layers.

It has been proposed that dissolution in the Ochoan Series rocks has been occurring since Permian times and that episodes of dissolution are similar because each episode involves uplift causing dissolution and erosion of surface and near-surface rocks (Bachman 1983). The period of strongest dissolution is thought to have taken place during Tertiary times when many units west of the Pecos River may have been completely dissolved and eroded, and large amounts of surficial material filled in the troughs and depressions. The project area is in a transitional area between the western and eastern portions of the Delaware Basin. Portions of the Rustler and Salado formations have been removed by dissolution, while to the east and south, where the deeper areas have not been exposed, the evaporite layers are still present. Mapped thicknesses of the evaporites appear to thin from east to west. Evidence of removal is derived from tracing the recognizable blanket-dissolution breccias into the basin and correlating them with existing salt layers. Of particular concern is the presence of evaporite karst because evaporite minerals are much more soluble than calcium carbonate. As a result, dissolution of evaporites can occur rapidly when exposed to water, compared to the dissolution of limestone. Most of the karst in the Delaware Basin is evaporite karst.

Sinkholes are common in the Nash Draw and Burton Flat areas and are primarily developed in the gypsum that outcrops or is near the surface (Hill 1996). Sinkholes are small depressions in the earth’s surface that are manifestations of rock dissolution that has taken place in the subsurface. Sinkholes are commonly small elliptical or circular features. However, sometimes sinkholes can attain dimensions in the hundreds of meters (Galloway et al. 2008).

Karst features occur when sinkhole development is widespread and multiple sinkholes coalesce to form a sizable depression. Two major karst valleys occur in or near the project area: Nash Draw and Burton Flat (see **Figure 3.2-5**). The north end of Nash Draw begins south of the project area. Nash Draw extends for 15 miles north to south and is 5 to 6 miles wide (Vine 1963). Burton Flat is west of the project area, and is described as a "karst plain" by Hill (1996). Burton Flat is about 13 miles north to south and east to west (Dane and Bachman 1958). In both areas, the bedrock is primarily in the Rustler Formation and the valleys are characterized by sinkholes, caves, and interior drainage.

Within the project area, karst is manifested in a number of features, some of which can be identified on the surface and others are hidden in the subsurface (Hill 1996). The Capitan Reef contains cavernous areas in the subsurface and anomalously high porosity, indicating the presence of large vugs, or "honeycomb" structure, and evidence of rock dissolution (Hill 1996). The Capitan Limestone does not outcrop in the project area, but is present in the subsurface. The formation of cavernous porosity may be relevant to the formation of karst features such as breccia pipes.

Caves, another karst feature present in the project area, developed in gypsum bedrock. Numerous caves and pits have been identified and cataloged by the BLM and the Southwest Region National Speleological Society (1991). Hill (1996) reported 20 to 40 caves in Nash Draw. Some of the caves in or near the project area are as deep as 50 to 60 feet with entrances located at the bottom of sinkholes up to 30 feet deep. Some caves in the project area that have been surveyed are in excess of 800 feet long and 75 feet deep. Cave entrances vary from 16 to 30 feet high and from 40 to 90 feet long. In one case, an underground void was observed to be within 15 feet of the edge of the running surface of a major paved road. At another cave, a nearby gravel road collapsed due to the void breaching the surface. It has been observed that cave development in some cases has been enhanced by erosion during heavy precipitation events.

The cave/karst potential ratings in and near the project area (total area of 277,778 acres) are summarized in **Table 3.2-2** and displayed on **Figure 3.2-8**. There are 106 known caves and numerous karst features in the vicinity of the project area. The primary area of karst concern, which contains an exceptionally high density of karst features such as depressions and sinkholes, is located in and near the western portion of the project area. Within this dense karst area, it is estimated that there are as many as 120 karst features per square mile in the southern portion of Burton Flats. To delineate this area and identify karst features, the BLM used satellite imagery to locate features that are visible at the ground surface, ranging from closed depressions to sinkholes with small openings in the bottom to sinkholes with large cave entrances in the bottom.

Karst features and caves are point sources for groundwater recharge because they allow for the rapid transmission of surface water to the subsurface environment. This groundwater recharge can affect karst formation by supplying fresh water that dissolves soluble rock, causing the creation of underground voids and eventual collapse. Water from precipitation and near-surface karst aquifers is critical to troglobitic species (small cave-dwelling animals adapted to their dark surroundings) that inhabit the numerous cave systems in the primary area of karst concern. Several of the caves in the Burton Flats karst plain extend down to permanent water sources. On average, the water levels found in the caves are 80 to 90 feet below the ground surface. Within the vicinity of the project area, identified as the Groundwater Modeling Domain on **Figure 3.2-8**, it is estimated that 47 of the 106 known caves (44 percent) are located where the existing groundwater table is within 90 feet of the ground surface. The other caves may derive water from precipitation or a perched water table.

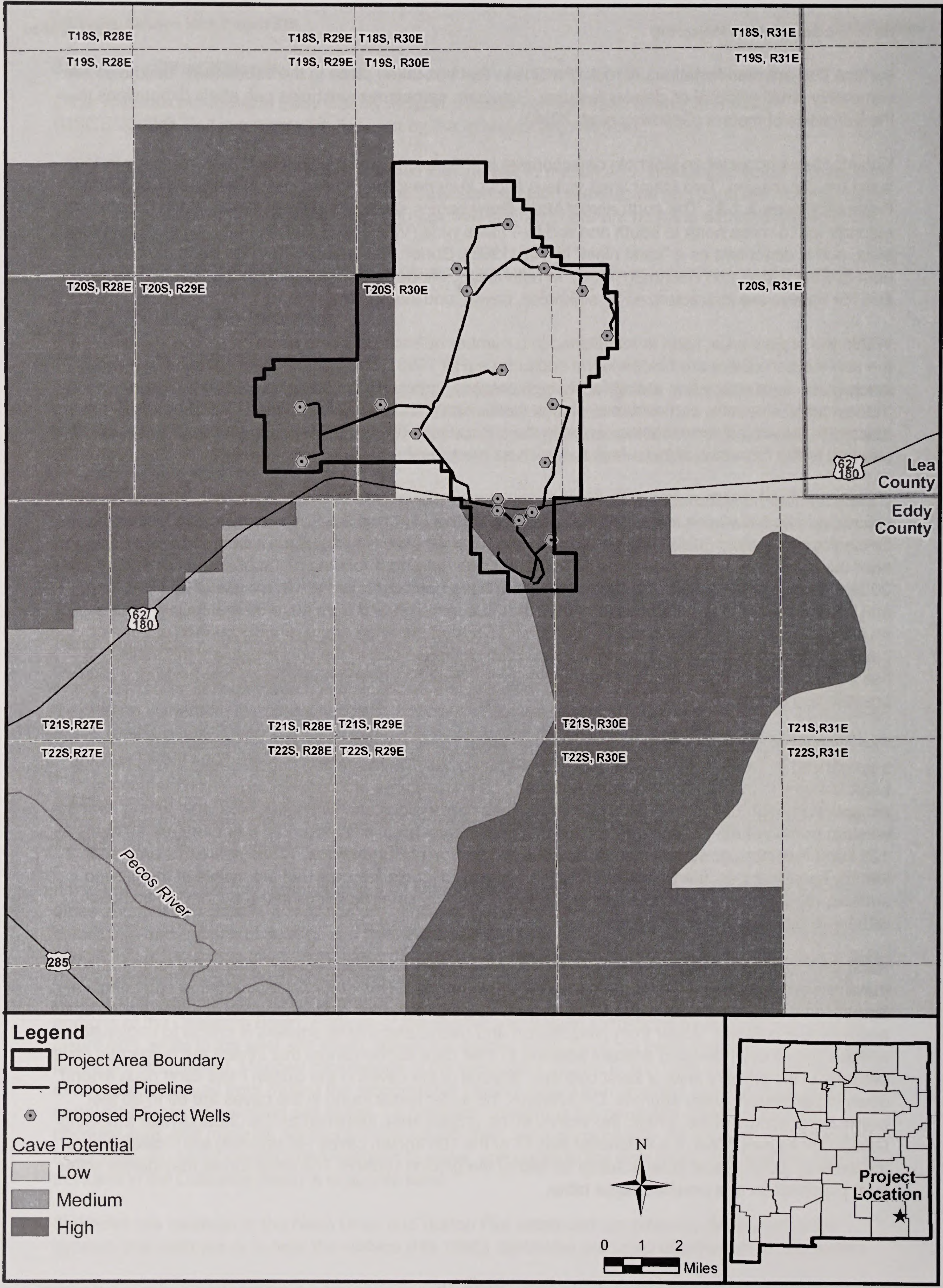


Figure 3.2-8 Cave/Karst Potential in the Vicinity of the Project Area

Table 3.2-2 Cave/Karst Potential Ratings in the Project Area

Cave/Karst Potential Rating	Acres	Rating Definition
High	103,202	Areas of known karst geology that contain high density of significant caves and karst features
Medium	72,867	Areas of known karst geology that contain dispersed caves and karst features
Low	101,709	Areas of questionable karst geology and few if any known caves or karst features
Total	**277,778**	

The caves provide habitat for various fauna including bats, rodents, and rattlesnakes. A few caves have been nominated as Significant Caves under the Federal Cave Resources Protection Act of 1988 based on biological, recreational, geological, and hydrological values. However, many of the caves in or near the project area have not been explored and documented in detail by biological inventories.

Breccia pipes are an unusual feature in the project area, and have been described in detail by Vine (1960) and Bachman (1983). The pipes occur on the surface as circular domes, approximately 1,200 to 1,500 feet in diameter and about 50 to 100 feet high (Vine 1960). Drilling and exposures in the Intrepid West underground mine has shown that the matrix of the breccia pipes consists of tilted and erratic blocks of rock material derived from the Salado and Rustler formations (Snyder and Gard 1982). The breccia pipes are thought to have originated from solution and collapse of voids in the Capitan Limestone, but also could have resulted from the dissolution of salts or anhydrites higher in the section. One theory surmises that when dissolution caused breaching of the Capitan Limestone, the loss of support caused the layer above to collapse. Artesian conditions in the Capitan Limestone then forced unsaturated water upward, causing continual collapse that resulted in unsaturated water coming in contact with soluble salts (Davies 1983; Hill 1996). The dissolution of the evaporites caused additional collapsing, creating the dome effect. The caliche layer on the domes dates the pipes to around 600,000 years before present.

Of the four documented breccia pipes in the vicinity (see **Figure 3.2-5**), two are located in the project area, in the SW¼ of Section 35, T20N, R30E (Dome A) and in the NW¼ of Section 1 and the NE¼ of Section 2 in T21S, R29E (Dome B). Two other breccia pipes or domes are located on the east side of Intrepid's West Mine in the SW¼ of Section 5, T21S, R30E. Dissolution breccias or blanket-dissolution breccias occur where subsurface solutions have dissolved the evaporite layer, leaving the insoluble residue (Hill 1996). Such breccias can be widespread in the subsurface, and their presence is evidence of the dissolution of salt. A blanket breccia zone at the top of the Salado Formation is present in Nash Draw (see **Figure 3.2-5**).

Oil has been observed where mine workings have intercepted one of the breccia pipes. Geochemical fingerprinting reveals the oil to be similar to oil from the Yates Formation produced in the Getty, Barber, PCA, and Dos Hermanos oil fields (Palacas et al. 1982). The presence of oil similar to Yates reservoirs supports the pipe formation theory described above because artesian water from the Capitan Limestone may have carried oil from breached traps in the Yates Formation to higher levels. Other evidence supporting the possible migration of fluids from deeper zones comes from an exploratory oil well drilled in 1938. The Neil Wills State 2-A well in the SE¼ NE¼ Section 19, T20S, R30E, located on the west flank of the Barber Field, had a recorded rise in water level from the oil zone between 1,647 and 1,650 feet deep to about 1,200 feet in 9 hours (OCD 2009a,b). Information is not provided in the description of well testing to determine whether the fluid was allowed to rise to the maximum height possible. The information provides evidence of a hydraulic head strong enough that, if allowed, might rise enough to affect evaporite layers in the Salado Formation. Anhydrite and limestone were reported at a depth of 1,165 to 1,293 feet in the well with a base of salt at about 1,000 feet. The well was judged to be inadequate for commercial production and was plugged and abandoned.

Anthropogenic (Human-caused) Subsidence

In the Delaware Basin, anthropogenic subsidence largely has occurred as a result of potash mining and activities involving the withdrawal of fluids for oil and gas production.

Subsidence from Potash Mining. Subsidence is the phenomenon or response that occurs when an underground opening is created and some of the rock is removed. The overlying and surrounding rock or soil around the opening naturally deforms in an effort to arrive at a new overall equilibrium position. This equilibrium-seeking action can result in both vertical and horizontal ground movement, and if not controlled or minimized, can cause damage to both surface and subsurface structures. In addition, it can result in the development of changes to the surface topography, such as surface cracking or collapse, sinkholes, blockage or re-channelization of streams, and modification of drainage pathways.

For the HB In-Situ Solution Mine Project, subsidence concerns relate to the method of mining utilized to extract the potash ore, the “room-and-pillar” mining method (see **Figure 3.2-6**). In this mining method a substantial proportion of the target mineral is locked up in the pillars and is often removed during the latter stages of mining (e.g., on retreat, often referred to as “pillar robbing” or “second mining”), usually to the extent that the number, size, or distribution of remaining pillars is insufficient to continue to support the roof.

The removal of potash ore via historical underground mining operations in the project area resulted in localized surficial depressions and near-vertical stress cracks, both of which are expressions of subsidence (Intrepid Potash Inc./Shaw 2008b). The areal extent of subsidence extends beyond the limits of the mine workings and is defined by the angle of influence. The angle of influence has been observed at various local mines to range from 45 to 55 degrees. The HB potash mines have an angle of influence of approximately 45 degrees (measured from the horizontal).

Specific examples of surface exposures of subsidence effects in the project area include the alluvium contained “in a depression south of Section 2 and adjacent to Highway 31” (Intrepid Potash Inc./Shaw 2008c). This feature shows ditch-like, parallel depressions that resemble typical subsidence fractures over mining subsidence. South of Highway 31 is an area where drainage has been disturbed by a series of parallel trends that presumably also depict the effects of subsidence over mined areas. Stress cracks are present in areas of Sections 23 and 26, T20S, R29E. It is likely that these types of features may be present throughout the project area wherever historic underground workings exist.

Other possible mining-related subsidence features occurred on Eddy County Road 238 (Section 23, T20S, R29E) (Goodbar 2010). Located over the HB Eddy Mine and observed in 1993, the features were described as long tension fractures running across the paved county road and extending on both sides of the road for 50 to 100 feet. The fractures were approximately 0.5 to 1.0 inch wide and more than 3.0 feet deep. Up to 5 fractures were parallel to each other, perhaps 8 to 10 feet apart.

Other incidents have occurred in the vicinity of the mines, but they may not be related to mine subsidence (Goodbar 2010). A reported collapse occurred along Eddy County Road 360 in 1987 (Section 23, T19S, R30E). The location is at the north end of HB North Mine and the road was a state highway at the time. The collapse was approximately 35 to 40 feet deep and 20 feet across. Representatives from the potash company that owned the mine at the time were present at an on-site inspection with the New Mexico State Highway Department and the BLM. The potash company representative did not state whether the collapse was mine-related or confirm that the location was over mine workings. The highway department further collapsed the sides of the hole, backfilled it with packed debris, and reconstructed the road.

Subsidence Related to Oil and Gas Production. Oil and gas exploration and production in the Delaware Basin has been prolific. Thousands of wells have been drilled through evaporite formations to explore for and produce oil and gas. Drilling and completion operations must be conducted in a manner that prevents the dissolution of the salt and protects the well during drilling and throughout the productive lives of the wells, often 20 to 30 years or more.

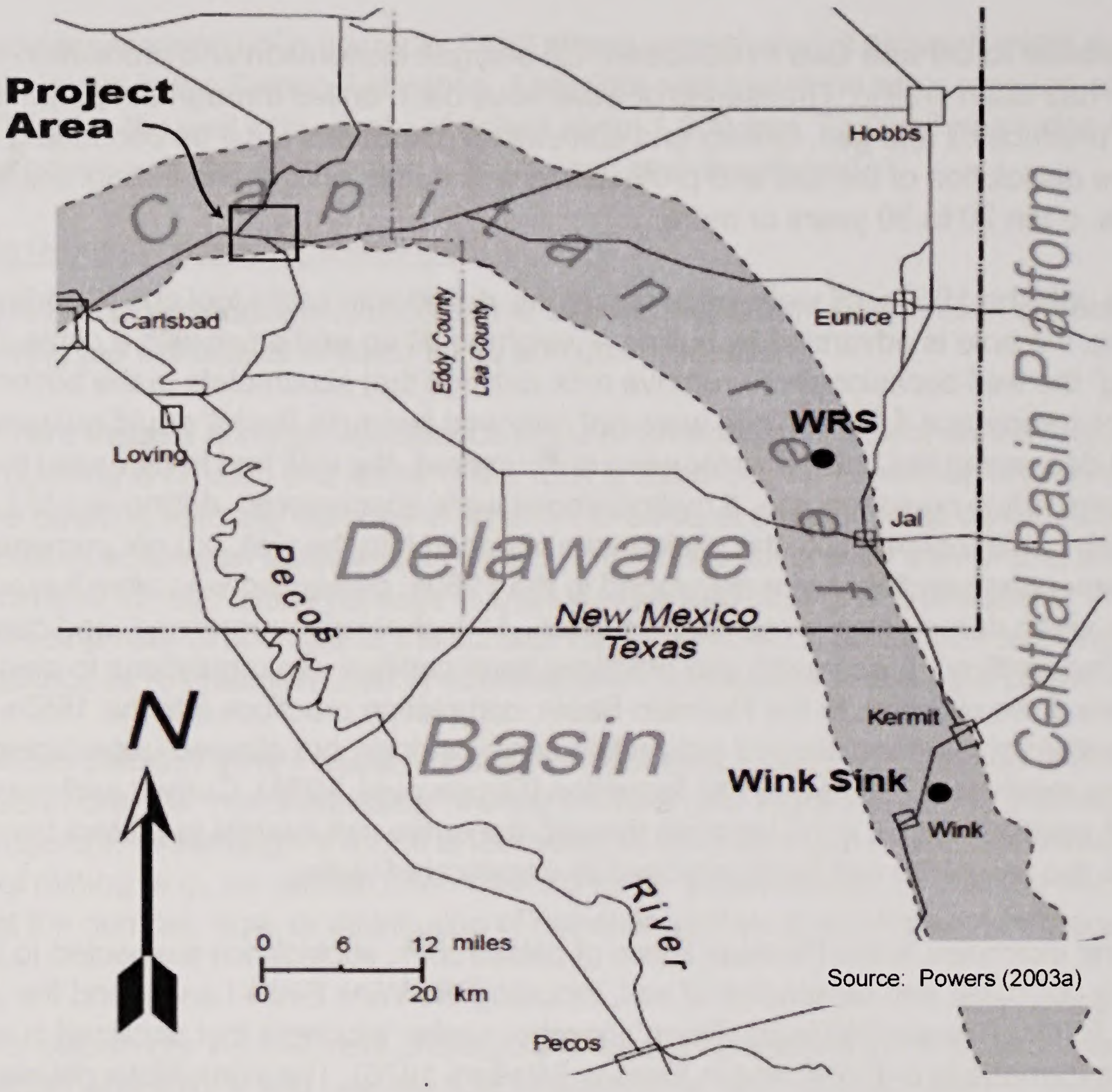
From the 1920s until the 1950s, oil wells were commonly drilled with cable tool rigs (Cearley 2000). In cable tool drilling, the hole is advanced by pulling a weighted bit up and down with a cable. The method required "bailing" the well occasionally to remove rock cuttings that accumulate in the bottom of the well. Drilling could not commence if the cuttings were not removed because the bit would pulverize the cuttings without deepening the bore. If water were encountered, the well had to be cased through the water zone before drilling could resume. If hydrocarbons were encountered, drilling would have to stop for safety. In early cable tool practice, the casing was pounded into the well, but not cemented. Although standardized cementing practices were developed in the 1930s, cementing was often based on guess-work, especially when determining proper setting times. As technology progressed, and cementing became more standardized, procedures and practices were codified into regulations to ensure that cement jobs were done properly. In the Permian Basin, completion practices into the 1950s required cement at the bottom of intermediate and production casing strings, but allowed unprotected casing to be exposed to as much as 2,000 feet of salt formation (Giroux et al. 1988). Current well construction rules in the SPA require cement to be installed through the entire salt interval to protect the casing string and to decrease the risk of the salt being exposed to unsaturated water.

There are several examples in the Permian Basin of catastrophic subsidence suspected to be the result of oil field casing corrosion and dissolution of salt, including the Wink Sinks I and II and the Jal sinkhole (Johnson et al. 2003a; Powers 2003a,b). There are other similar incidents that occurred in areas underlain by salt formations in Texas and in Kansas (Walters 1978). The Wink Sinks developed in the Hendrick oil field in Winkler County, Texas, near the Town of Wink (**Figure 3.2-9**).

The Jal sinkhole is located about 8 miles northwest of Jal, New Mexico. The geologic settings of the Wink Sinks and the Jal sinkhole are similar to the project area, occurring at the basin margin above the Capitan Reef. In each incident, sinkholes formed around a well location. Although the exact cause of sinkhole development is unknown, it is suspected that casing failure allowed unsaturated water to come into contact with, and subsequently dissolve, salt layers. **Figure 3.2-10** shows the postulated development of the Wink sink showing cavitations and subsidence caused by leaking casing, with ultimate surface collapse not occurring until years after the well was plugged.

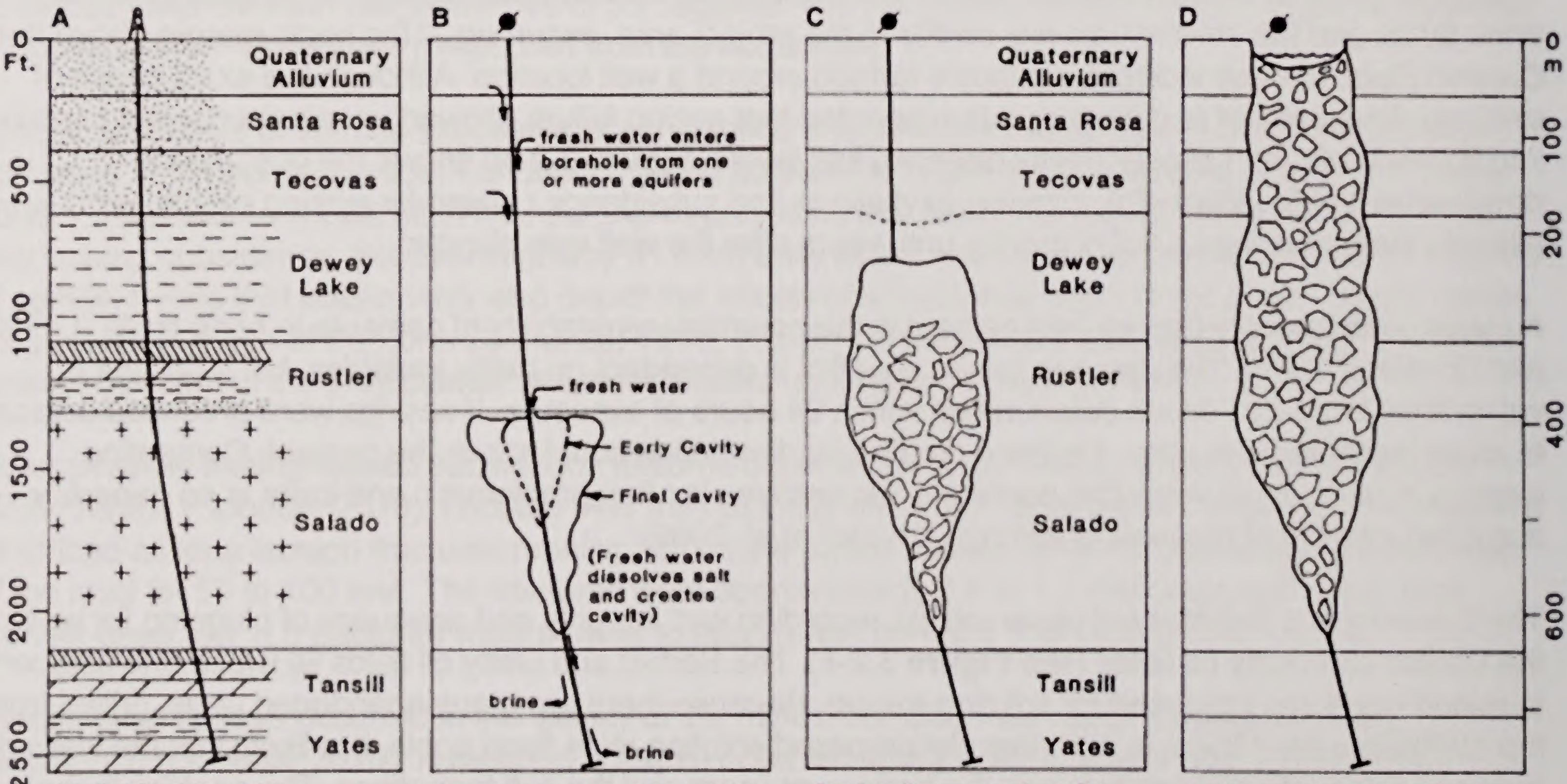
A major concern regarding oil field cement is the potential vulnerability of cements to brine fluids (LaFleur and Lovelace 1969). The damage brine can inflict is dependent on many variables, but if cement is vulnerable, brine can cause deterioration within 24 hours of exposure. If casings were breached adjacent to an uncemented salt zone, the brine created by dissolution could attack the cement. Cementing casings in oil and gas wells that penetrate salt sections is often problematic and there is no generally accepted method of preventing damage (Hunter et al. 2009).

The following is a summary of observations regarding well integrity and adequacy of plugging for wells in the Barber and Getty oil fields (see **Figure 3.2-7**). The Barber and Getty oil fields lie within and adjacent to mined out areas proposed for solution mining. Because there are many abandoned wells, drilled from the 1920s into the 1950s, in and near the proposed solution mine flood pools, it is likely that the wells did not have adequate cement between the casings or liners and the salt formations. The geology technical report (AECOM 2010a) prepared for the BLM in support of this EIS provides observations on well integrity and adequacy of plugging wells within the Barber and Getty fields, as well as detailed documentation of the status and location of the wells. The report also describes evidence from oil, gas, and salt water disposal wells in the area that suggests subsidence or other contamination problems have resulted and may continue if left untreated.



Source: Powers (2003a)

Figure 3.2-9 Location of Wink Sink



Well drilled in 1928. Borehole is crooked.

Oil produced from 1928-1951. Well plugged in 1951 and 1964. Cavity develops between 1928-1980.

Roof collapses and cavity migrates upward (1980?)

Collapse reaches surface June 3, 1980.

Source: Johnson (2005)

Figure 3.2-10 Development of Wink Sink

USGS topographic mapping and information in OCD (2009a) environmental incident files indicate evidence of a closed, shallow depression in the vicinity of the Barber Oil Field. The origin of the depression is not known, it may be subsidence from mining, dissolution of soluble beds due to unrestricted unsaturated fluids that have escaped from oil wells, disposal of unsaturated produced water, or the result of natural karst processes.

Subsidence Related to Halite Solution Mining. Salt can be extracted from subsurface formations by using wells that inject fresh water to dissolve the salt. The saturated brine is then extracted. In the Delaware Basin, these wells are referred to as brine wells. Brine wells in the Delaware Basin are used to extract salt for oil and gas well drilling and workover fluids (Griswald 2009). Recently, a few brine wells suffered catastrophic collapse.

The first collapse occurred at Jim's Water Service about 10 miles northwest of the project area in Section 24, T18S, R28E. The collapse occurred on July 15, 2008, and the sinkhole created eventually reached dimensions of 400 feet across and 120 feet deep, and reportedly continues to grow (Griswald 2009).

The second collapse occurred on November 3, 2008, at the Loco Hills Water Disposal located in Section 16, T17S, R30E, about 12 miles north of the project area. A week after the collapse, the diameter of the sinkhole was estimated to be 195 feet across. By May 2009, the sinkhole was 290 feet across and about 200 feet deep.

3.2.3.2 Seismicity

Earthquakes

The proposed project is located in an area with very little earthquake activity and such events that are recorded are of small magnitude. From 1973 to the present there have been 28 recorded events, the largest of which was 4.1 on March 28, 2010 (USGS 2010).

Active Faults

No active faults have been identified in southeastern New Mexico (USGS and New Mexico Bureau of Mines and Mineral Resources 2006). The nearest potentially active faults are located about 60 miles south of the project area in the Guadalupe and Delaware Mountains in Texas (Collins 1993a,b).

Ground Motion

The USGS seismic hazard mapping indicates that ground motion in the project area from a maximum credible event would be less than 10 percent of the acceleration of gravity, with a 2 percent probability of exceedence in 50 years (Petersen et al. 2008).

3.2.3.3 Landslides

Although escarpments are physiographic features in the vicinity of the proposed project, the overall landslide risk is low (National Atlas 2009).

3.2.4 Paleontological Resources

3.2.4.1 Regulatory Structure

Federal protection for scientifically important paleontological resources applies to construction or other impacts caused by disturbance of paleontological resources that occur on federally owned or managed lands. Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (PL 59-209; 16 USC 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federally administered lands. Another federal law regulating paleontological resources is the Archaeological and Paleontological

Salvage Act (23 USC 305). This act provides for funding for mitigation of paleontological resources discovered during federal highway projects, provided that "excavated objects and information are to be used for public purposes without private gain to any individual or organization." In addition to the foregoing, the National Registry of Natural Landmarks provides protection to paleontological resources.

The BLM manages paleontological resources (fossils) on federal lands under the following statutes and regulations (BLM 2010a):

- FLPMA of 1976 (P.L. 94-579).
- NEPA of 1969 (P.L. 91-190).
- Various sections of BLM's regulations found in Title 43 CFR that address the collection of invertebrate fossils and, by administrative extension, fossil plants.
- A recently enacted statute, the Paleontological Resources Preservation Act, was passed in March 2009. The law authorizes the BLM and USFS to manage and provide protection to fossil resources using "scientific principles and expertise" (BLM 2010a).
- Petrified (fossilized) wood is protected under BLM regulations at 43CFR 3620-3622.

In addition to the statutes and regulations listed above, fossils on public lands are managed through the use of internal BLM guidance and manuals. Included among these are the BLM Manual 8270 and the BLM Handbook H-8270-1 (BLM 2010a). Various internal instructional memoranda have been issued to provide guidance to the BLM in implementing management and protection to fossil resources.

Potential Fossil Yield Classification

Recently, the BLM adopted the Potential Fossil Yield Classification (PFYC) system to identify and classify fossil resources on federal lands (BLM 2007a). Paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

The PFYC system is a way of classifying geologic units based on the relative abundance of vertebrate fossils or scientifically significant fossils (plants and invertebrates) and their sensitivity to adverse impacts. A higher class number indicates higher potential. The PFYC is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis, and should be used to assist in determining the need for further mitigation assessment or actions. The BLM intends for the PFYC system to be used as a guideline rather than rigorous categories. Descriptions of the potential fossil yield classes are summarized in **Table 3.2-3**.

3.2.4.2 Paleontological Resources in the Project Area

The surface units in the project area consist of the Permian Ochoan Series (Rustler Formations and Dewey Lake Red Beds), Triassic Santa Rosa Formation, Gatuña Formation, Mescalero Caliche, and recent alluvial and windblown sand deposits, as described in Section 3.2.1. **Table 3.2-4** provides a summary of the paleontological resources and potential of the geologic units in the project area.

Table 3.2-3 Potential Fossil Yield Classification

Class	Description	Basis	Comments
1	Igneous and metamorphic (tuffs are excluded from this category) geologic units or units representing heavily disturbed preservation environments that are not likely to contain recognizable fossil remains.	• Fossils of any kind known not to occur except in the rarest of circumstances. • Igneous or metamorphic origin. • Landslides and glacial deposits.	Ground-disturbing activities will not require mitigation except in rare circumstances.
2	Sedimentary geologic units not likely to contain vertebrate fossils or scientifically significant invertebrate fossils.	• Vertebrate fossils known to occur very rarely or not at all. • Age greater than Devonian. • Age younger than 10,000 years before present. • Deep marine origin. • Aeolian origin. • Diagenetic alteration.	Ground-disturbing activities are not likely to require mitigation.
3	Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Also sedimentary units of unknown fossil potential.	• Units with sporadic known occurrences of vertebrate fossils. • Vertebrate fossils and significant invertebrate fossils known to occur inconsistently; predictability known to be low. • Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.	Ground-disturbing activities will require sufficient mitigation to determine whether significant paleontological resources occur in the area of a proposed action. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.
4	Class 4 geologic units are Class 5 units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation.	• Significant soil/vegetative cover; outcrop is not likely to be impacted. • Areas of any exposed outcrop are smaller than 2 contiguous acres. • Outcrop forms cliffs of sufficient height and slope that most is out of reach by normal means. • Other characteristics that lower the vulnerability of both known and unidentified fossil localities.	Proposed ground-disturbing activities will require assessment to determine whether significant paleontological resources occur in the area of a proposed action and whether the action will impact the paleontological resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.

Table 3.2-3 Potential Fossil Yield Classification

Class	Description	Basis	Comments
5	Highly fossiliferous geologic units that regularly and predictably produce invertebrate fossils and/or scientifically significant invertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.	• Vertebrate fossils and/or scientifically significant vertebrate fossils are known and documented to occur consistently, predictably, and/or abundantly. • Unit is exposed; little or no soil/vegetative cover. • Outcrop areas are extensive; discontinuous areas are larger than 2 contiguous acres. • Outcrop erodes readily; may form badlands. • Easy access to extensive outcrop in remote areas. • Other characteristics that increase the sensitivity of both known and unidentified fossil localities.	Mitigation of ground-disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

Sources: BLM 2008, 2007a.

Table 3.2-4 Summary of Potential Paleontological Resources in the Project Area

Geologic Unit	Description of Paleontological Resources	Fossil Potential Based on PFYC
Alluvium and wind-blown deposits	Because such deposits are younger than 10,000 years old, there would be a low potential for fossils.	Class 2—Low potential for the presence of important fossils.
Mescalero Caliche	Caliche is formed by the precipitation of calcium carbonate from water that has percolated into soil layers (Bachman 1985). The presence of fossils is not expected since the calcium carbonate is not produced by organic processes.	Class 1—The nature of the formation of caliche would likely preclude the presence of fossils.
Cave Deposits	Cave deposits (Pleistocene to Recent in age) consisting of breccias, breakdown blocks, and water laid sediments can host a variety of vertebrate fossils (Harris 1993; Hill 1987).	Class 4—There is a high potential for scientifically important fossils to be found in caves.

Table 3.2-4 Summary of Potential Paleontological Resources in the Project Area

Geologic Unit	Description of Paleontological Resources	Fossil Potential Based on PFYC
Gatuña Formation	Although vertebrate fossils may be present in the Gatuña Formation (Harris 1993; Miller 1982); Vine (1963) did not describe fossils in the Nash Draw area and none were noted in the general vicinity of the proposed project (Dehler and Pederson 1998).	Class 2—There is a potential for the occurrence of fossils, but probably are rare. The occurrence of vertebrate fossils in the formation was not reported until 1982 (Miller 1982).
Ogallala Formation	The Ogallala has the potential to contain important vertebrate fossils, but identified localities occur mainly in Texas (Schulz 1972). However, fossil tracks have been found at the base of the Ogallala northeast of Roswell (Williamson and Lucas 1996)	Class 4. The abundance of documented vertebrate fossil occurrences indicates a high potential.
Santa Rosa Formation	Localities in Texas at the Llano Estacado escarpment contain reptile, amphibian, and other small vertebrate fossils (Lehman and Chatterjee 2005). In the Nash Draw area the formation contains "carbonaceous plant fragments and fossil reptile bones and teeth" (Vine 1963).	Class 3—Vertebrate fossils have been found in the formation, but the presence of vertebrates not predictable in the project area.
Dewey Lake Red Beds	No fossils identified by Vine (1963).	Class 2—There is a potential for the occurrence of fossils, but probably are rare.
Rustler Formation	Work by Walter (1953) described mollusks in the Culebra Member of the Rustler Formation in outcrops in Culbertson County, Texas 50 to 60 miles south of the project area. However, Walter (1953) described fossil localities in the Rustler Formation as "scarce, random occurrences."	Class 3—Applicable only to the Culebra Member since fossils are present and potentially important for scientific purposes, however widespread and rare. The remaining members of the formation would be considered Class 2.

3.3 Water

3.3.1 Surface Water

Surface water resources have been characterized in this report for two overlapping areas, the SPA and the project area. When discussing the project area, subwatersheds that contain any portion of the project area will be discussed and addressed. Beyond the SPA area, there also is discussion of the Pecos River, more specifically the water rights related interstate compact between New Mexico and Texas, known as the Pecos River Compact of 1948.

3.3.1.1 Precipitation and Evaporation

The climatic conditions in the SPA were characterized through the records of seven weather stations in and near the project area maintained by the Western Regional Climate Center (WRCC 2010). The climate of the area is semi-arid with average annual precipitation ranging from 12 to 16 inches. The average monthly minimum and maximum temperatures range from 94 to 98 degrees Fahrenheit (°F) in July with average monthly minimums of 28 to 30°F in December and January. Average annual potential evaporation rates far exceed average annual precipitation. Evaporation rates may approach 73 inches per year in this area (WRCC 2010), resulting in a large moisture deficit for many months of the year. The large moisture deficit limits stream flow because most precipitation is easily absorbed by the dry soils. However, during times of heavy precipitation the capacity of soils for infiltration is surpassed by the rate of rainfall, causing surface water runoff. Streamflows in the area are limited to periods of heavy precipitation.

3.3.1.2 Subwatersheds and Stream Channels

The Watershed Boundary Dataset (WBD) (National Resources Conservation Service [NRCS] 2005) divides the entire nation into drainages or subwatersheds. The nation (including Alaska, Hawaii, and the U.S. Virgin Islands) is divided into 21 Regions. Each region is divided into approximately 15 subregions, which are further divided into a similar number of basins, subbasins, watersheds, and subwatersheds. Each level is represented by a 2-digit code, known as the Hydrologic Unit Code (HUC). Effectively, each subwatershed has a unique 12-digit HUC identification number. The project area falls within six subwatersheds (NRCS 2005), shown in **Figure 3.3-1**. **Table 3.3-1** lists the six subwatersheds that contain a portion of the project area.

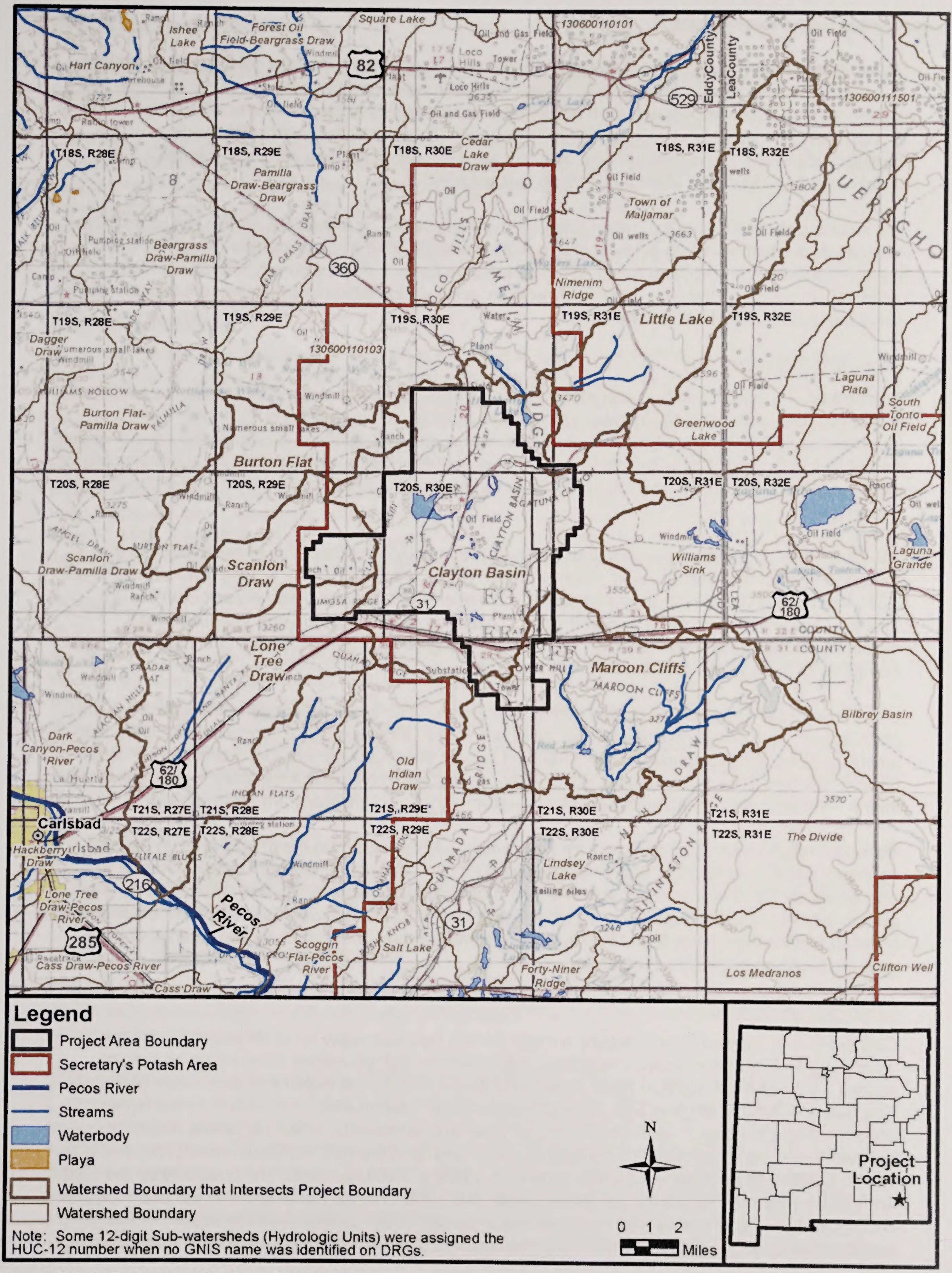
Table 3.3-1 Subwatersheds that Contain Portions of the Project Area

Region	Basin	Subbasin	Watershed	Subwatershed	Connected/ Closed	HUC-12 ID
Rio Grande	Upper Pecos[1]	Upper Pecos-Black	Burton Flat	Burton Flat	Connected	130600110104
			Clayton Basin	Little Lake	Closed	130600110203
				Clayton Basin	Closed	130600110204
				Scanlon Draw	Connected	130600110205
			Pamilla Draw	Lone Tree Draw	Connected	130600110308
			Salt Lake[2]	Maroon Cliffs	Connected	130600111701

[1] Upper Pecos is name of Subregion (HUC-4) and Basin (HUC-6).

[2] Salt Lake Watershed (HUC-8) is a closed basin.

Source: NRCS 2005.



Note: Some 12-digit Sub-watersheds (Hydrologic Units) were assigned the HUC-12 number when no GNIS name was identified on DRGs.

Figure 3.3-1. Subwatersheds in Project Area

Stream channels have been identified using the National Hydrography Dataset (NHD) (USGS 2009b). This dataset is associated with the WBD 12-digit HUC numbers. Stream reaches are coded using the corresponding WBD numbers and then additional digits are added to the number to differentiate each stream reach. The NHD also defines the flow regime of identified streams, within the confines of the dataset, and provides a flow network (when one exists) for water resource analyses. **Figure 3.3-1** includes the NHD features within and near the project area.

The subwatersheds listed above relate to other drainages in and near the SPA area in two ways. Some watersheds are hydrologically connected to another subwatershed through the flow of surface water in stream channels or as overland runoff. When a drainage basin is a closed basin, it does not have an outlet into an adjacent drainage or basin. Therefore, precipitation falling inside a closed basin will remain within the boundaries of the watershed.

Connected Subwatersheds

Burton Flat. This subwatershed encompasses a very small portion of the project area in the northeast, or most upslope portion of the drainage area. Burton Flat can be characterized as sloping from approximately 3,350 feet amsl in the northeast to approximately 3,220 feet amsl in the southwest where it empties into Scanlon Draw-Pamilla Draw. Water could then flow to Lone Tree Draw, and eventually to the Pecos River. Burton Flat is a relatively flat subwatershed that does not contain mapped channels of streamflow.

Scanlon Draw. The project area intersects with approximately one-fifth of this subwatershed in the eastern portion of the drainage area. Scanlon Draw can be characterized as sloping from approximately 3,320 feet amsl in the east to approximately 3,200 feet amsl in the southwest, where it empties into Scanlon Draw-Pamilla Draw for a short distance. Water could then flow to Lone Tree Draw, and eventually to the Pecos River. Scanlon Draw contains only two ephemeral stream channels at the lower elevations of the western portion of the subwatershed.

Lone Tree Draw. Only a small portion of the project area is contained within this subwatershed in the northeastern corner of the drainage. It can be characterized as sloping from approximately 3,480 feet amsl in the northeast to approximately 3,050 feet amsl in the southwest where it drains to the Pecos River. Lone Tree Draw has several mapped ephemeral stream channels in the steep, upper areas and in the mid-elevation area to the northwest where water might be contributed from Scanlon Draw.

Maroon Cliffs. Only a small portion of this subwatershed intersects with the project area, in the northwest portion of Maroon Cliffs. This drainage area can be characterized as sloping generally from approximately 3,600 feet amsl in the northern portion to approximately 3,100 feet amsl in the southern portion, where it could flow into Lindsey Lake Subwatershed. Lindsey Lake Subwatershed is considered a closed basin, where flows from Maroon Cliffs accumulate through Nash Draw into a series of lakes near the southern edge of this drainage.

Closed Subwatersheds

Clayton Basin. Clayton Basin contains a major portion (approximately ¾) of the project area. This drainage area is a closed basin, characterized by relatively high elevations surrounding an area of relatively low elevation. Clayton Basin is bounded on the west by the higher elevation areas of Burton Flat, Scanlon Draw, and Lone Tree Draw subwatersheds. It is bounded on the south by the higher elevation areas of Maroon Cliffs and Old Indian Draw subwatersheds, where elevations reach approximately 2,520 feet amsl. To the east, it is bounded by Williams Sink, Greenwood Lake, and Little Lake subwatersheds where elevations range from 3,600 to 3,400 feet amsl. The boundary on the north is created by watersheds where elevations range from 3,260 to 3,400 feet amsl. The low elevation areas in Clayton Basin consist of several locations where surface water collects near the middle at elevations ranging from 3,340 to 3,200 feet amsl. Very few ephemeral stream channels have been mapped along areas in the eastern portion of this subwatershed where steep slopes have likely caused erosion features to develop.

Little Lake. This subwatershed contains a very small portion of the northeast corner of the project area. Little Lake subwatershed can be characterized as a closed basin that generally slopes from elevations of approximately 4,500 feet amsl in the northeast towards the lowest elevations in the southwest portion of the drainage, approximately 3,390 feet amsl. Little Lake subwatershed is separated from Clayton Basin to the southwest by a minor ridge at approximately 3,400 feet amsl. There is only one mapped ephemeral channel in this subwatershed, located near the lower elevations and in an area of steeper slopes.

Playas and Salt Ponds

Within the project area, the closed Clayton Basin subwatershed contains 45 waterbodies identified by the NHD (USGS 2009a). No other subwatershed contains any NHD waterbody features in the project area. Of the 45 waterbodies, two are perennial. These perennial features have little surface area and are located next to one another along U.S. 180-62. The perennial features are located at a relatively high elevation compared to other waterbodies within the subwatershed. There also are three features classified as treatment reservoirs, which are the largest NHD features and have likely been used for discharge of water extracted from oil and gas wells. The remaining waterbodies are identified as intermittent salt lakes, which also could be interpreted as playas characteristic of the area. Playas are created when precipitation runoff leaches salts from the soil during runoff, collects in the low-lying areas, and then evaporates. The salts left behind decrease infiltration rates into the soil and allow water to pool.

Floodplains

The Federal Emergency Management Agency (FEMA) maintains maps of flood-prone areas throughout the nation that they use for administering the National Flood Insurance Program. In Eddy County, New Mexico, these maps are part of the Flood Insurance Rate Map (FIRM) series. FIRM maps are coded according to flood potential and level of analysis performed regarding that potential. The project area includes only two zones. Zone A is defined as areas that are within the 100-year floodplain (area with 1 percent or greater probability of a flood occurring in any given year). Projected elevations where flooding occurs in Zone A have not been determined. Zone X is defined as areas outside the 500-year floodplain (0.2 percent or less probability of a flood occurring in any given year) (FEMA 1991).

The Zone A areas in the project area correspond very closely with low-lying areas that are defined as waterbodies by the NHD (see Section 3.1.2.3). In addition, there is one additional topographic depression west of the largest treatment reservoir that has been identified as Zone A, the designation for the 100-year floodplain.

3.3.1.3 Wetlands and Riparian Areas

The USFWS maintains a series of maps that depict wetlands across the nation, called the National Wetlands Inventory (NWI). These maps were consulted to determine the types and extents of wetlands present in the project area.

Wetlands are classified according to Cowardin et al. (1979). Classifications include Palustrine and Lacustrine systems. Systems are further classified by hydrology that defines flooding as either semi-permanent, seasonal, intermittent, or temporary (USFWS 1990, 1984a). Palustrine wetland systems are relatively flat areas dominated by hydrophytic vegetation. Palustrine wetlands may be isolated or connected wet areas and include marshes, swamps, bogs, and small shallow ponds. Lacustrine wetland systems are deeper topographic depressions with vegetative coverage of less than 30 percent and are generally located along lakes.

Mapped wetlands in the project area are mostly located within floodplains and near NHD-defined waterbodies. The project area contains both palustrine and lacustrine wetlands, concentrated within the low-lying areas of Clayton Basin. The palustrine systems in the project area generally consist of the numerous smaller wetlands and are further classified on the larger scale maps as being temporarily flooded (USFWS 1990, 1984a). The lacustrine systems in the project area account for 7 of the approximately 30 wetlands identified by the USFWS (1990, 1984a), and consist of the larger mapped wetlands. These systems are further classified on the larger scale maps as being temporarily to semi-permanently flooded (USFWS 1990, 1984a).

3.3.1.4 Surface Water Quality

The New Mexico Water Quality Control Commission (NMWQCC) is responsible for setting water quality standards and designating beneficial uses for waterways. All surface waters of the state are assigned the beneficial uses of aquatic life, livestock watering, wildlife habitat, and secondary contact (NMAC 2009). Surface water quality is regulated in New Mexico by the Environment Department, Surface Water Quality Bureau. Water quality parameters are reported to the USEPA under the requirements of the CWA, specifically sections 303(d) and 305(b). The 303(d)/305(b) Integrated Report lists any streams that are considered impaired because they do not meet water quality standards or are not suitable for assigned beneficial uses. New Mexico's current 303(d)/305(b) Integrated Report was published in 2008 (NMWQCC 2008).

Naturally Occurring Water Quality

No waterbodies in the project area are reported as having impairments (NMWQCC 2008). Downstream from the project area, the Pecos River is listed as impaired from the confluence of the Black River near Malaga Bend to the Texas border. The impaired rating is due to the beneficial use, irrigation, in this reach not being supported because there are exceedences of dissolved boron limits, which may be attributable to inputs from the brine springs at Malaga Bend (Hopkins 2006).

Previous and Current Sources of Impacts to Water Quality

Although no waterbodies within the project area are considered impaired, there are historic impacts that have been documented. High total dissolved solids (TDS) concentrations occur from natural salt deposits near the surface and potentially from two anthropogenic sources: discharges from oil and gas wells and runoff from potash mine tailings (Geohydrology 1978).

3.3.1.5 Surface Water Use

Water use in the State of New Mexico is administered by the New Mexico Office of the State Engineer (NMOSE) under the prior appropriation doctrine, or "first in time, first in right." Any use of water must be permitted through the NMOSE, and is given a priority date based on when the application was received. All rights with "senior" (earlier) priority dates must be satisfied prior to "junior" (later) rights. The lack of surface water rights within the project area reflects the absence of surface water flows.

NMOSE Recorded Beneficial Uses

Intrepid Potash holds the only surface water right found in the project area, as returned by the NMOSE database (2010). The beneficial use of the right is for industrial purposes of tailings disposal and brine recovery.

Pecos River Compact

The Pecos River is downstream from the project area, and therefore hydrologically connected by surface water flows. The State of New Mexico and the State of Texas are parties to a compact ratified by Congress in 1949, the Pecos River Compact. After the ratification, the agreement was the subject of litigation that eventually came before the U.S. Supreme Court. In 1988, the Supreme Court entered an Amended Decree and appointed a River Master to administer the decree.

The Compact and Amended Decree apportion the flows of the Pecos River between the two states. Along with flows coming from Fort Sumner Dam (upstream from the project area) being specifically divided, flood inflows between the dam and the state line must be delivered to Texas. New Mexico is responsible for fulfilling the decreed amount of water that must cross the state line into Texas. If New Mexico does not comply, the River Master must create a plan to remedy any shortfall (Johnson et al. 2003b).

3.3.2 Groundwater

Groundwater resources are discussed in two different scales and geographic areas depicted in **Figure 1-1**: the first being the SPA and the second the project area. The groundwater resources in the SPA are discussed regionally, and the groundwater resources of the project area are discussed in greater detail. Estimated water balance for the SPA outlines and defines groundwater input and output parameters. Discussion of the groundwater resources northeast of the SPA includes detailed information regarding the aquifers in the Caprock well field area.

Physical properties of the aquifers discussed vary greatly, and are categorized by their relative magnitudes as described in **Table 3.3-2**. Water quality of the aquifers discussed is summarized by the TDS concentration. New Mexico considers all groundwater with a TDS of 10,000 mg/L or less to be protected for "present and potential future use as domestic and agricultural water supply" (NMAC 20.6.2.3101).

Table 3.3-2 Aquifer Property Categories and Values

	Units	Range		Classification in Text	Source
		High	**Low**		
Hydraulic Conductivity	ft/d	greater than	1x10^{-1}	High Flow Potential	
		1x10^{-1}	1x10^{-4}	Moderate Flow Potential	
		1x10^{-4}	or less	Low Flow Potential	
Transmissivity[1]	ft^2/d	greater than	1	High Flow Potential	
		1	1x10^{-5}	Moderate Flow Potential	
		1x10^{-5}	or less	Low Flow Potential	
TDS	mg/L	10,000	or less	"Protected" for future uses	NMAC 20.6.2.3101
		greater than	10,000	Not Protected	

[1] Transmissivity equals Hydraulic Conductivity multiplied by Saturated Thickness (Depth) of Aquifer.

Notes: ft/d = feet per day.
ft^2/d = square feet per day.
mg/L = milligrams per liter.

3.3.2.1 Groundwater Aquifers in the SPA

The SPA is underlain by the northern part of the Delaware Basin, whose northern border is formed by the Permian-age Capitan Reef complex. This area contains aquifers in many of the Permian stratigraphic units, but not in the Dewey Lake Red Beds or the Santa Rosa Formation. The Salado and Castile formations locally contain water with high TDS levels, but neither unit acts as an aquifer. The important aquifers that are potentially affected by potash mining and refining activities are located in the Rustler Formation and the Capitan Limestone. See Section 3.2.1 for detailed descriptions of the geologic formations.

There are five main aquifers in the northern part of the Delaware Basin that lie beneath the SPA. In addition, several other major formations act as aquitards. An aquitard is a geologic layer of low permeability adjacent to an aquifer that may store groundwater. Aquifers and aquitards in the vicinity of the project area are listed below from oldest (deep) to youngest (shallow):

- Bell Canyon aquifer of the Delaware Mountain Group
- Capitan aquifer
- Castile Formation aquitard
- Salado Formation aquitard
- Los Medaños aquifer of the Rustler Formation
- Culebra Dolomite aquifer of the Rustler Formation
- Tamarisk aquitard of the Rustler Formation
- Magenta Dolomite aquifer of the Rustler Formation
- Forty-niner aquitard of the Rustler Formation

The Dewey Lake Red Beds and the Santa Rosa Formation that overlie the above formations do not act as regional aquifers. **Figure 3.3-2** depicts the geology of the SPA from the Salado through the Dewey Lake Red Beds.

Bell Canyon Aquifer

The Bell Canyon is the upper member of the Delaware Mountain Group. The Lamar Shale member of the Bell Canyon and the overlying Castile Formation both act as impermeable aquitards that confine the aquifer in the Bell Canyon. These siltstone and shale layers have low flow potential and limit the vertical movement of water in the aquifer, while the horizontal movement of water in the sandstone layers is much less restrictive and has moderate flow potential (Mercer 1983). Well yields are low, less than 5 gpm. Groundwater flows northeast with a potentiometric surface (top of the groundwater) of 3,600 feet amsl by Malaga Bend and a potentiometric surface of 3,400 feet amsl beneath WIPP, and a gradient of approximately 25 to 40 feet per mile (Intrepid/Shaw 2008a).

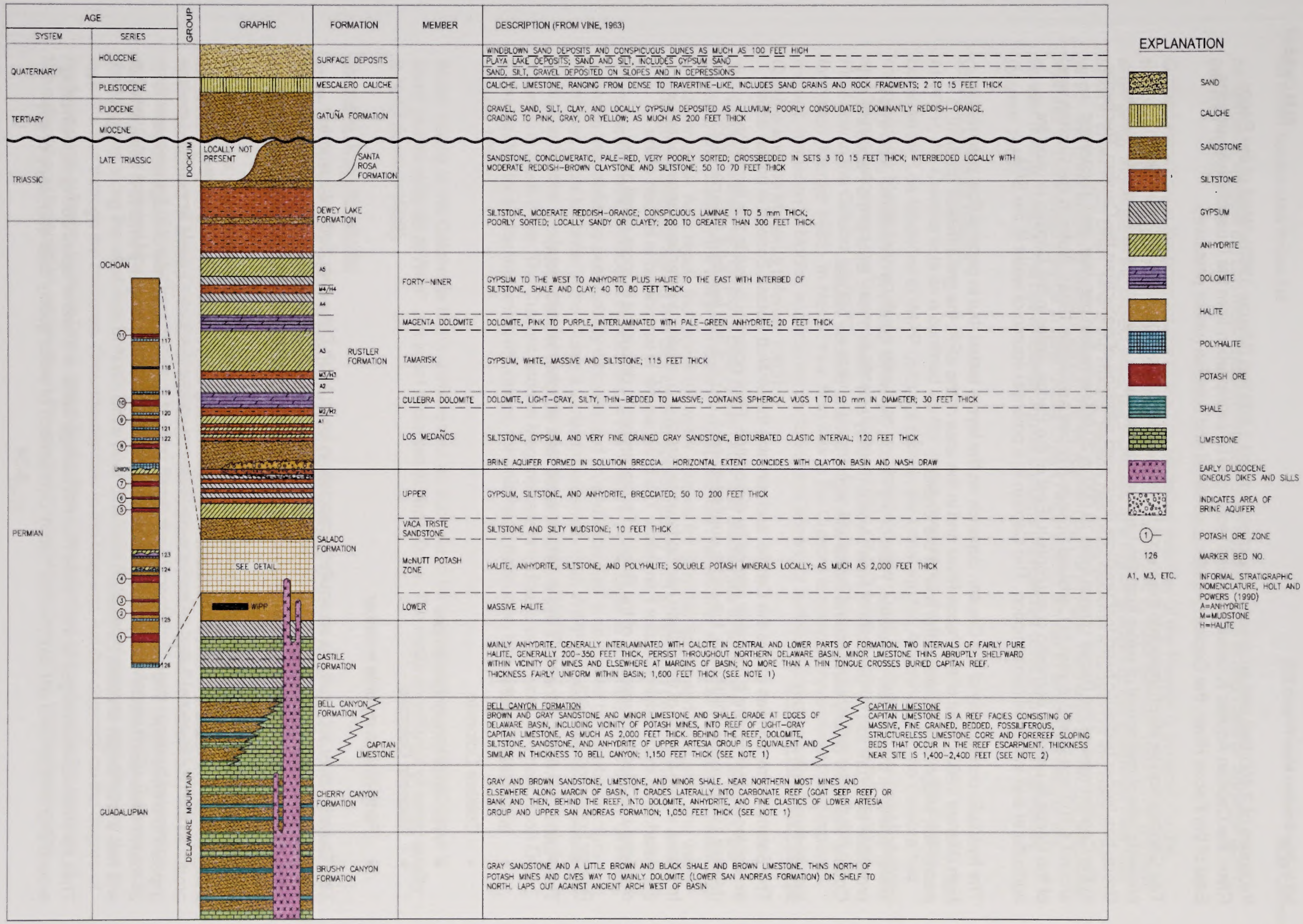
Water quality in the Bell Canyon is unprotected saline, consisting of sodium chloride brine with TDS ranging from 180,000 to 270,000 mg/L (Mercer 1983).

Castile Formation Aquitard

The Bell Canyon's high hydraulic head is limited vertically by the overlying Castile Formation. The Castile Formation consists of thick anhydrite with thin interbedded salt layers, which acts as an aquitard. Water is found in weathered sections of the Castile where it is exposed. It does not have a regional flow system and is not considered an aquifer. However, the water is used locally for wells used for stock watering. The Castile is 1,500 to 1,850 feet thick in the WIPP area (Mercer 1983). Hydraulic tests conducted at WIPP found the hydraulic conductivity to be too low for field measurement. This formation has very low flow potential (Mercer 1983). Local brine pockets containing gas have been encountered by oil/gas drilling in the region. The flow of brine in these exploration wells has been as high as 20,000 barrels per day (bpd) (Powers et al. 1978).

Capitan Aquifer

The Capitan Aquifer consists of the Capitan Limestone, the Goat Seep Formation, and the forereef and backreef facies associated with the Guadalupian Reef Complex (Richey and Wells 1984). The Capitan Aquifer's width at the north end of the Delaware Basin is about 10 to 14 miles and has a maximum



WINDBLOWN SAND DEPOSITS AND CONSPICUOUS DUNES AS MUCH AS 100 FEET HIGH

PLAYA LAKE DEPOSITS; SAND AND SILT, INCLUDES GYPSUM SAND

SAND, SILT, GRAVEL DEPOSITED ON SLOPES AND IN DEPRESSIONS

CALICHE, LIMESTONE, RANGING FROM DENSE TO TRAVERTINE-LIKE, INCLUDES SAND GRAINS AND ROCK FRAGMENTS; 2 TO 15 FEET THICK

GRAVEL, SAND, SILT, CLAY, AND LOCALLY GYPSUM DEPOSITED AS ALLUVIUM; POORLY CONSOLIDATED; DOMINANTLY REDDISH-ORANGE, GRADING TO PINK, GRAY, OR YELLOW; AS MUCH AS 200 FEET THICK

SANDSTONE, CONGLOMERATIC, PALE-RED, VERY POORLY SORTED; CROSSBEDDED IN SETS 3 TO 15 FEET THICK; INTERBEDDED LOCALLY WITH MODERATE REDDISH-BROWN CLAYSTONE AND SILTSTONE; 50 TO 70 FEET THICK

SILTSTONE, MODERATE REDDISH-ORANGE; CONSPICUOUS LAMINAE 1 TO 5 mm THICK; POORLY SORTED; LOCALLY SANDY OR CLAYEY; 200 TO GREATER THAN 300 FEET THICK

GYPSUM TO THE WEST TO ANHYDRITE PLUS HALITE TO THE EAST WITH INTERBED OF SILTSTONE, SHALE AND CLAY; 40 TO 80 FEET THICK

DOLOMITE, PINK TO PURPLE, INTERLAMINATED WITH PALE-GREEN ANHYDRITE; 20 FEET THICK

GYPSUM, WHITE, MASSIVE AND SILTSTONE; 115 FEET THICK

DOLOMITE, LIGHT-GRAY, SILTY, THIN-BEDDED TO MASSIVE; CONTAINS SPHERICAL VUGS 1 TO 10 mm IN DIAMETER; 30 FEET THICK

SILTSTONE, GYPSUM, AND VERY FINE GRAINED GRAY SANDSTONE, BIOTURBATED CLASTIC INTERVAL; 120 FEET THICK

BRINE AQUIFER FORMED IN SOLUTION BRECCIA. HORIZONTAL EXTENT COINCIDES WITH CLAYTON BASIN AND NASH DRAW

GYPSUM, SILTSTONE, AND ANHYDRITE, BRECCIATED; 50 TO 200 FEET THICK

SILTSTONE AND SILTY MUDSTONE; 10 FEET THICK

HALITE, ANHYDRITE, SILTSTONE, AND POLYHALITE; SOLUBLE POTASH MINERALS LOCALLY; AS MUCH AS 2,000 FEET THICK

MASSIVE HALITE

MAINLY ANHYDRITE, GENERALLY INTERLAMINATED WITH CALCITE IN CENTRAL AND LOWER PARTS OF FORMATION. TWO INTERVALS OF FAIRLY PURE HALITE, GENERALLY 200-350 FEET THICK, PERSIST THROUGHOUT NORTHERN DELAWARE BASIN. MINOR LIMESTONE THINS ABRUPTLY SHELFWARD WITHIN VICINITY OF MINES AND ELSEWHERE AT MARGINS OF BASIN; NO MORE THAN A THIN TONGUE CROSSES BURIED CAPITAN REEF. THICKNESS FAIRLY UNIFORM WITHIN BASIN; 1,600 FEET THICK (SEE NOTE 1)

BELL CANYON FORMATION

BROWN AND GRAY SANDSTONE AND MINOR LIMESTONE AND SHALE. GRADE AT EDGES OF DELAWARE BASIN, INCLUDING VICINITY OF POTASH MINES, INTO REEF OF LIGHT-GRAY CAPITAN LIMESTONE, AS MUCH AS 2,000 FEET THICK. BEHIND THE REEF, DOLOMITE, SILTSTONE, SANDSTONE, AND ANHYDRITE OF UPPER ARTESIA GROUP IS EQUIVALENT AND SIMILAR IN THICKNESS TO BELL CANYON; 1,150 FEET THICK (SEE NOTE 1)

CAPITAN LIMESTONE

CAPITAN LIMESTONE IS A REEF FACIES CONSISTING OF MASSIVE, FINE GRAINED, BEDDED, FOSSILIFEROUS, STRUCTURELESS LIMESTONE CORE AND FOREREEF SLOPING BEDS THAT OCCUR IN THE REEF ESCARPMENT. THICKNESS NEAR SITE IS 1,400-2,400 FEET (SEE NOTE 2)

GRAY AND BROWN SANDSTONE, LIMESTONE, AND MINOR SHALE. NEAR NORTHERN MOST MINES AND ELSEWHERE ALONG MARGIN OF BASIN, IT GRADES LATERALLY INTO CARBONATE REEF (GOAT SEEP REEF) OR BANK AND THEN, BEHIND THE REEF, INTO DOLOMITE, ANHYDRITE, AND FINE CLASTICS OF LOWER ARTESIA GROUP AND UPPER SAN ANDREAS FORMATION; 1,050 FEET THICK (SEE NOTE 1)

GRAY SANDSTONE AND A LITTLE BROWN AND BLACK SHALE AND BROWN LIMESTONE. THINS NORTH OF POTASH MINES AND GIVES WAY TO MAINLY DOLOMITE (LOWER SAN ANDREAS FORMATION) ON SHELF TO NORTH. LAPS OUT AGAINST ANCIENT ARCH WEST OF BASIN

Figure 3.3-2. Stratigraphic Column of the Salado and Rustler Formations (Intrepid Potash, Inc./Shaw 2008a)

thickness of 2,400 feet and an average thickness around 1,500 feet (Mercer 1983). West of the Pecos River, the Capitan Aquifer is unconfined and recharged by precipitation from the Guadalupe Mountains. East of the Pecos River, the Capitan Aquifer is confined and artesian (under pressure).

The Capitan Aquifer discharges into the Pecos River at Carlsbad Springs. The Castile Formation prevents lateral movement of water from the Capitan into the basin. The underlying Delaware Mountain Group has higher hydraulic head that prevents downward seepage of water from the Capitan. Recharge to the Capitan west of the Pecos ranges from 10,000 to 20,000 acre-feet per year, and discharges around 4,500 acre-feet per year to Carlsbad Springs (Richey and Wells 1984). Water in the Capitan west of the Pecos is used for domestic consumption. East of the Pecos, water in the Capitan is used for agricultural and industrial consumption. The Capitan is a potential source of water in the SPA.

The hydraulic conductivity of the Capitan depends on the layers tested, but in general flow potential is high (Mercer 1983). East of the Pecos River and in the area of the SPA, the groundwater gradient is nearly flat, suggesting limited lateral flow in the Capitan.

Water quality in the Capitan is variable. West of the Pecos, the water quality is considered good and is protected for future use by the State of New Mexico (Richey and Wells 1984). East of the Pecos in Eddy County, the water quality can become saline with high TDS and chloride values.

Salado Formation Aquitard

The Salado Formation lies above the Castile, and contains the McNutt Potash Zone. It is not an aquifer except for in areas where it has been altered by dissolution. Flow potential is low in this formation (Mercer 1983). In the WIPP area, the unit is unaltered and 1,700 to 2,300 feet thick (Mercer 1983).

In places where the top of the Salado has undergone dissolution, a brine aquifer has formed between the Salado and the overlying Rustler Formation. The brine aquifer is considered to be part of the overlying Los Medaños member of the Rustler Formation and is discussed in more detail below.

Rustler Formation Aquifers

The Rustler Formation consists of five members listed from deepest to shallowest:

- Los Medaños member
- Culebra Dolomite
- Tamarisk evaporite member
- Magenta Dolomite
- Forty-niner evaporite member

The Tamarisk may act locally as an aquifer, especially in lower Nash Draw near Salt Lake where dissolution has caused considerable collapse of the Rustler (Mercer 1983). The Los Medaños contains a brine aquifer that is found throughout Nash Draw, and both the Culebra and the Magenta are aquifers.

Los Medaños Brine Aquifer

Dissolution of the upper 200 feet of the Salado Formation along the contact with the overlying Rustler produced the Los Medaños brine aquifer, a zone of clay residuum containing seams of brecciated gypsum and sandstone. The brecciated seams are 10 to 60 feet in thickness and average around 24 feet in thickness (Mercer 1983). This zone underlies Nash Draw and ranges from 2 to 8 miles in width and has a total length of about 26 miles.

The Los Medaños discharges to the Pecos River at Malaga Bend at a rate of about 200 gpm, delivering around 342 tons of NaCl per day (Mercer 1983). Comparison of water quality data and ratios of key constituents suggest the Los Medaños brine aquifer does not discharge to Salt Lake or Surprise Spring (Mercer 1983).

Groundwater flow in the brine aquifer of the Los Medaños member of the Rustler is generally to the southwest, as indicated by the potentiometric surface documented in 1982 (Mercer 1983). The gradient is generally moderate in the project area, but increases to a higher gradient to the southwest near Salt Lake in lower Nash Draw, where the Rustler section has collapsed due to erosion of the Salado. At WIPP, the brine aquifer is present only in the far western part of the site. Recharge for the Los Medaños member of the Rustler may be in Bear Grass Draw (T18S, R30E), similar to other members of the Rustler (Mercer 1983). The Los Medaños aquifer contains unprotected brine with high TDS values (Mercer 1983).

Culebra Dolomite Aquifer

At WIPP, the Culebra acts as a confined aquifer and is considered the first aquifer above the Salado, because the Los Medaños at WIPP does not contain the brine aquifer. At Nash Draw, the Culebra has collapsed into blocks forming drape structures and karst mounds due to dissolution in the Los Medaños and Salado below and the Tamarisk above (Mercer 1983). The Culebra outcrops at the Pecos River. Fluid flow in the Culebra at WIPP is mainly fracture flow along bedding planes and fractures in the formation (Mercer 1983). In Nash Draw, fluid flow in the Culebra is complex because of the collapse of the unit, formation of blocks, and intense fracturing that allows for hydraulic communication between the Culebra and the Magenta (Mercer 1983).

The Culebra is likely recharged at Bear Grass Draw and discharges to Salt Lake. The Tamarisk, the Culebra, and possibly the Magenta have all collapsed into one another near Salt Lake due to dissolution in the Tamarisk. As a result, they are likely water sources for Surprise Spring and Salt Lake. The water discharges to Surprise Spring and Salt Lake at approximately 115 to 125 gpm (Mercer 1983).

The potentiometric surface of the Culebra at WIPP and in Nash Draw is generally to the south. Gradient changes are related to permeability changes and groundwater flow is controlled by variable fracture orientation. Flow potential in the Culebra varies considerably from WIPP to Nash Draw and especially within Nash Draw. Flow potential is moderate near the east side of WIPP, and increases to a high flow potential in Nash Draw. The Culebra and the Magenta are in hydraulic communication near Nash Draw, as suggested by similar transmissivity values, minimal head difference, and similar water quality (Mercer 1983).

Water quality in the Culebra is highly variable and as such could be considered as protected water in some places such as at WIPP, but is not protected in Nash Draw. The major constituent of water quality is NaCl (Mercer 1983).

Magenta Dolomite Aquifer

In the Magenta Aquifer, water is found in the siltstone and silty dolomite beds, along bedding planes, and in fractures. The aquifer is confined at WIPP and generally unconfined in Nash Draw where it is extensively fractured. In places in Nash Draw, the Magenta Aquifer can be confined and unsaturated.

In Nash Draw, the nature of the Magenta depends on dissolution in the Tamarisk and the presence of gypsum in both the Tamarisk and the Forty-niner members. In the northern, central, and along the eastern boundary of Nash Draw the Magenta is a relatively continuous bed (Mercer 1983). In the southwestern part of Nash Draw and near Malaga Bend, the Magenta has been removed by erosion, collapsed into isolated blocks, or formed karst sinks and collapse breccias (Mercer 1983). Exposures of the Magenta along the west side of Nash Draw near Quahada Ridge are fractured and often dry due to loss of water through the fractures. Groundwater flow in the Magenta Aquifer depends on the degree of fracturing and collapse. In Nash Draw, groundwater flow is fracture flow and very complex because of the collapse and brecciation, especially in the southern part of Nash Draw. The 1982 potentiometric surface for the Magenta Aquifer indicates groundwater flow in this unit is generally to the west (Mercer 1983). Flow potential in this aquifer ranges from moderate near WIPP to high flow potential in the Nash Draw area. The groundwater gradient at WIPP is around 16 to 20 feet per mile, increasing to 32 feet per mile on the west side of WIPP by Nash Draw. The gradient down Nash Draw is 13 feet per mile. Static head differences between the Magenta and the Culebra are less than 8 feet at wells in Nash Draw, suggesting hydraulic communication between the two aquifers (Mercer 1983). At WIPP, static head differences between the Magenta and the Culebra are around 115 to 155 feet. Recharge for the Magenta probably takes place in Bear Grass Draw. Discharge is through downward flow to other units in Nash Draw, and through contributing flows to either Salt Lake or the Pecos River at Malaga Bend (Mercer 1983).

Water quality in the Magenta is highly variable ranging from protected to unprotected TDS values.

Formations Above the Rustler

None of the formations above the Rustler in the SPA contain continuous zones of groundwater, so none constitute aquifers. The Dewey Lake Red Beds consist of a sequence of alternating beds of siltstone, mudstone, and lenticular sandstone deposited after the period of evaporite deposition in the late Permian. These beds of sands and silts thicken to the southeast up to 541 feet thick east of WIPP (Mercer 1983). The Dewey Lake is present only in low bluffs north and east of Nash Draw. It has been eroded from most of the Nash Draw area, and no water was encountered in drill holes (Mercer 1983). At the James Ranch (Sections 6 and 7, T23S, R31E), saline groundwater used for stock watering has been found at depths of 94 and 212 feet. The Dewey Lake is a low permeability unit that protects the underlying Rustler from infiltration of precipitation and removal of halite (Mercer 1983).

The Santa Rosa has a thickness ranging from less than a few feet to 176 feet at WIPP. It is found in the low bluffs at the north end of Nash Draw and along the east side of Nash Draw. It serves as the principal aquifer in southern Lea County, but in the SPA it only has water in the lower part of the formation at WIPP where yields are low.

The Gatuña is a discontinuous bolson deposit that ranges up to 143 feet thick at WIPP, but it is generally less than 46 feet thick (Mercer 1983). The Gatuña has an erratic distribution and no permanent water. It is not an aquifer.

Alluvium along the Pecos River west of the SPA serves as an aquifer with high flow potential and communication both to the river and possibly to underlying formations. Wind-blown sands and other thin alluvium within the SPA may be wet at times, but do not constitute an aquifer.

3.3.2.2 Project Area Hydrogeology and Groundwater Chemistry

In the project area, groundwater pumping is proposed from Sections 1 and 2, T21S, R29E from the Magenta member of the Rustler Formation (Rustler South), and from Section 4, T20S, R30E from the collapsed Magenta and Culebra members of the Rustler Formation (Rustler North). For this reason, most of the detailed field analyses and data gathering for the proposed project has been in these areas. The following discussion of the project area hydrogeology and groundwater chemistry focuses on the Rustler South and Rustler North areas. **Figures 3.3-3** through **3.3-6** present the structure contours for important geologic units in the Rustler South and North areas, in order from bottom to top strata.

Rustler Formation

The Los Medaños basal member of the Rustler is approximately 13 feet thick in the project area.

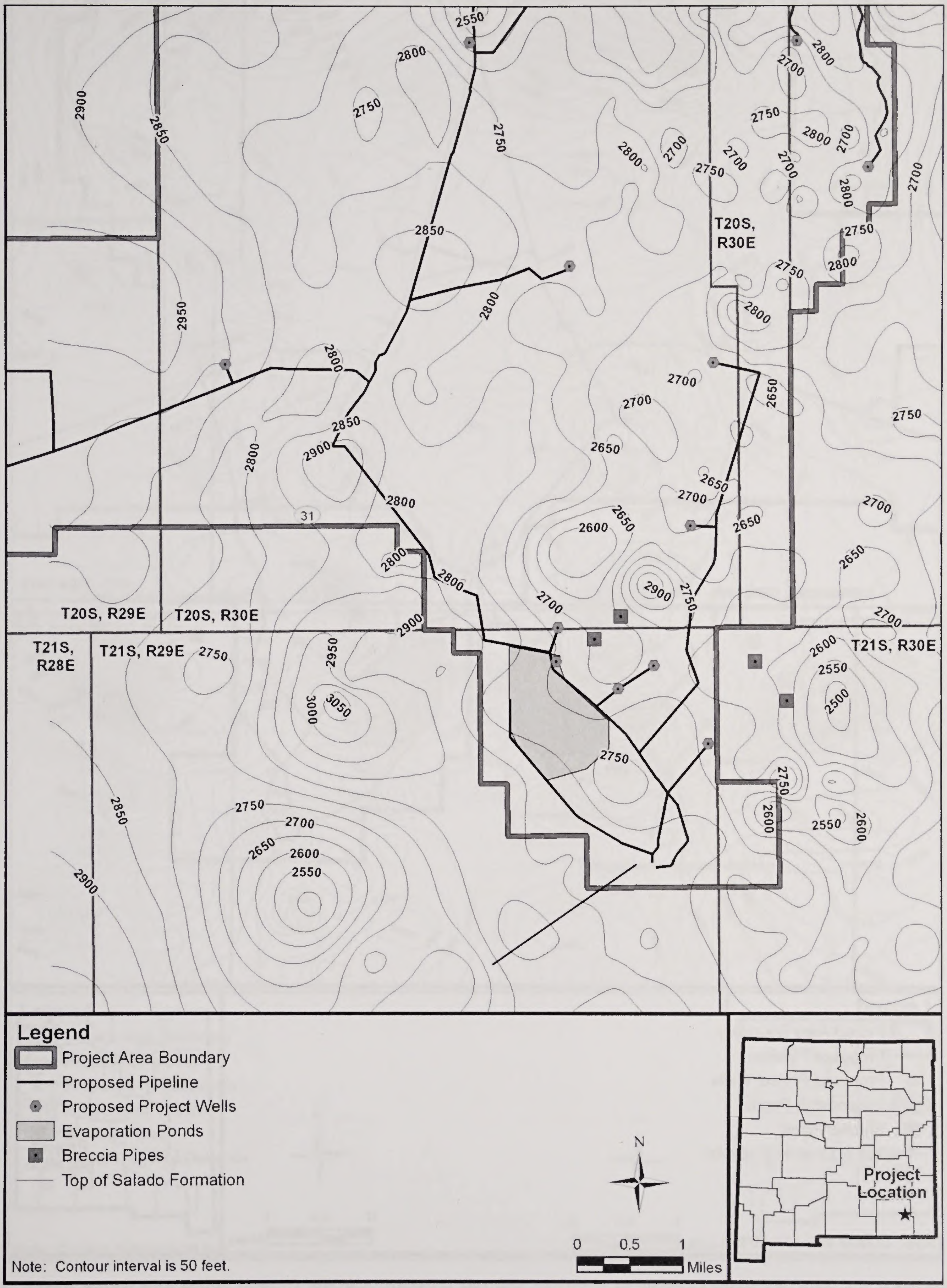


Figure 3.3-3. Top of Salado Formation in the Rustler North and South Areas

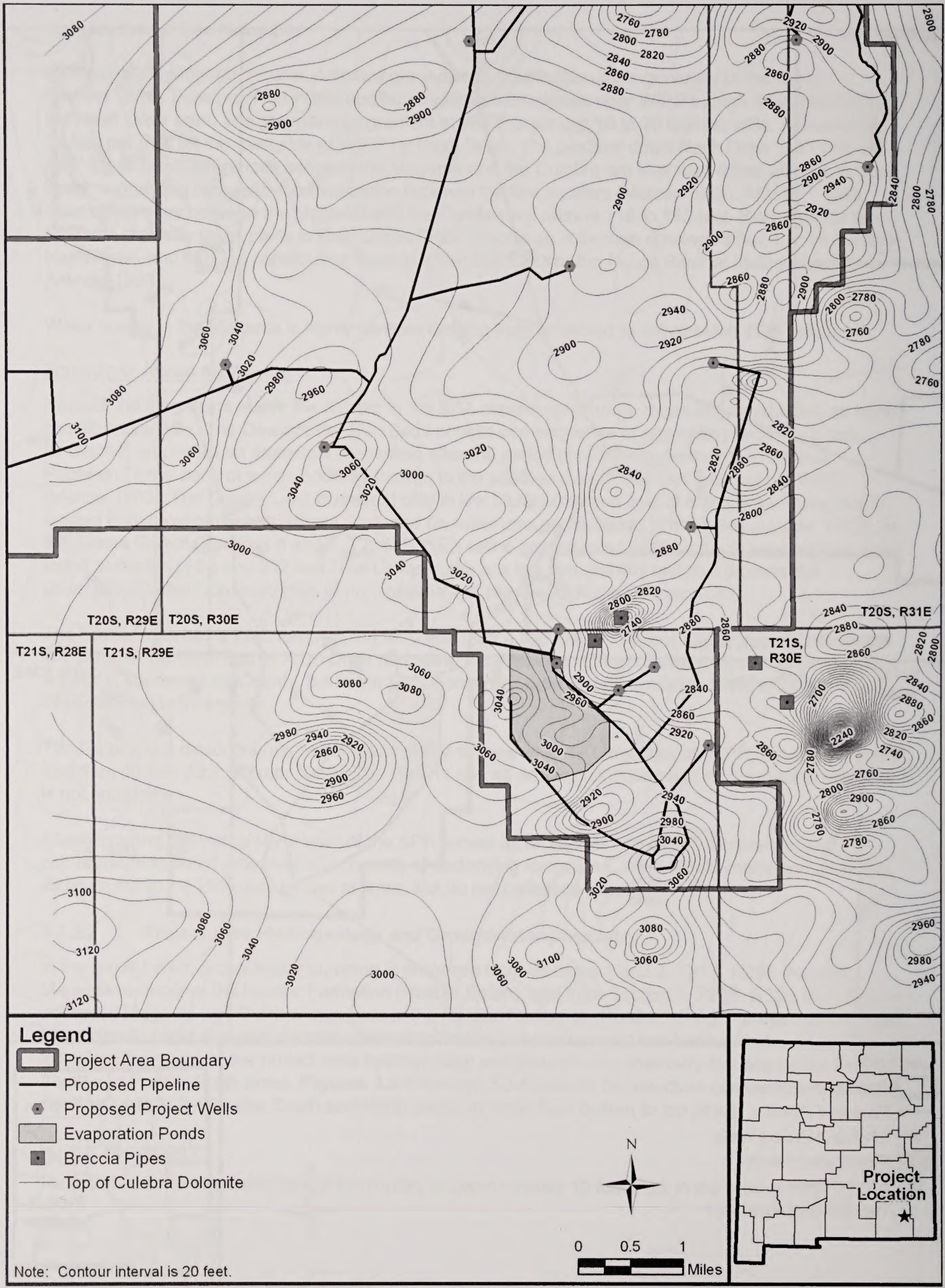


Figure 3.3-4. Top of Culebra Dolomite Member, Rustler Formation in the Rustler North and South Areas

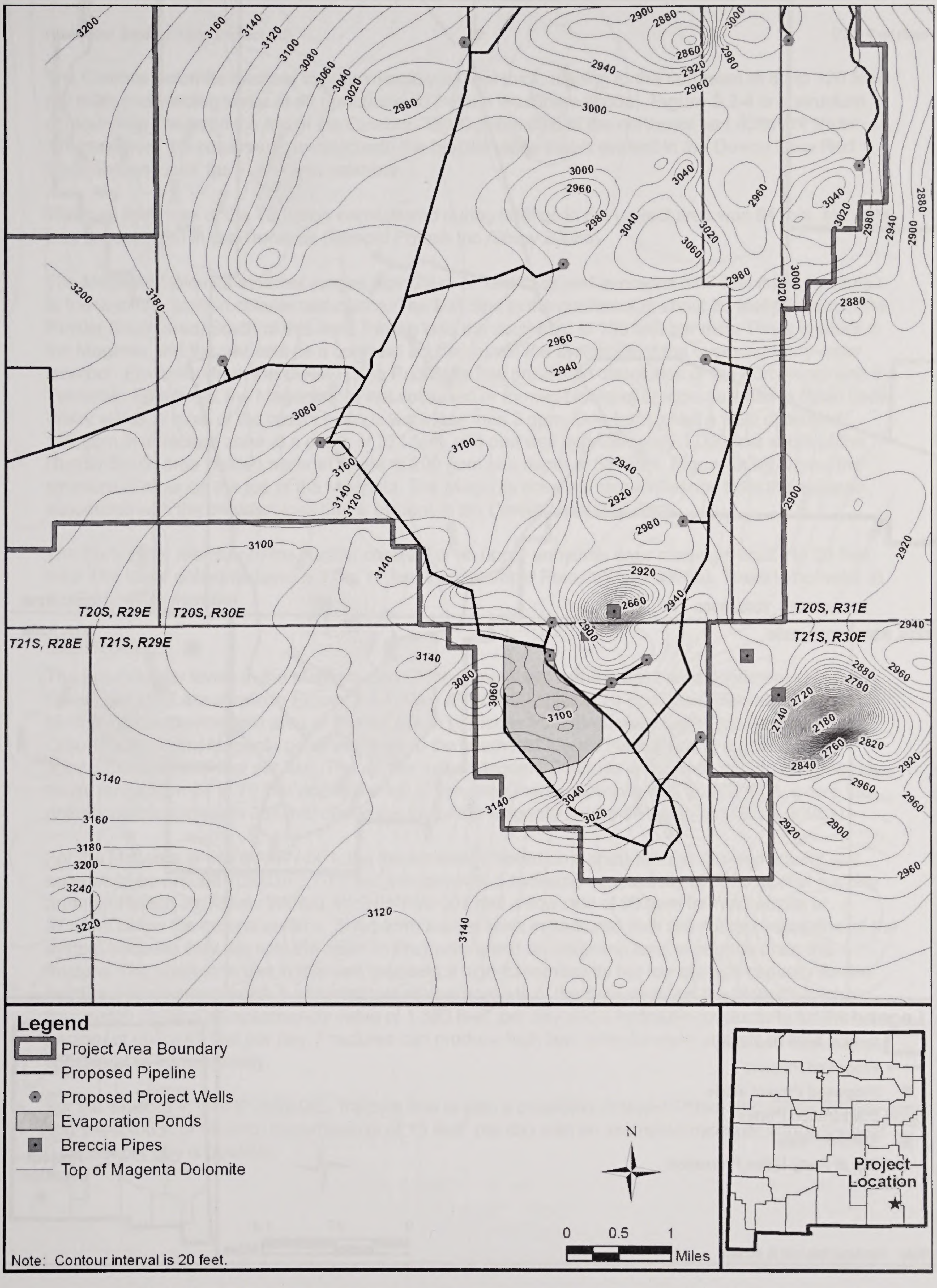


Figure 3.3-5. Top of Magenta Dolomite Member, Rustler Formation in the Rustler North and South Areas

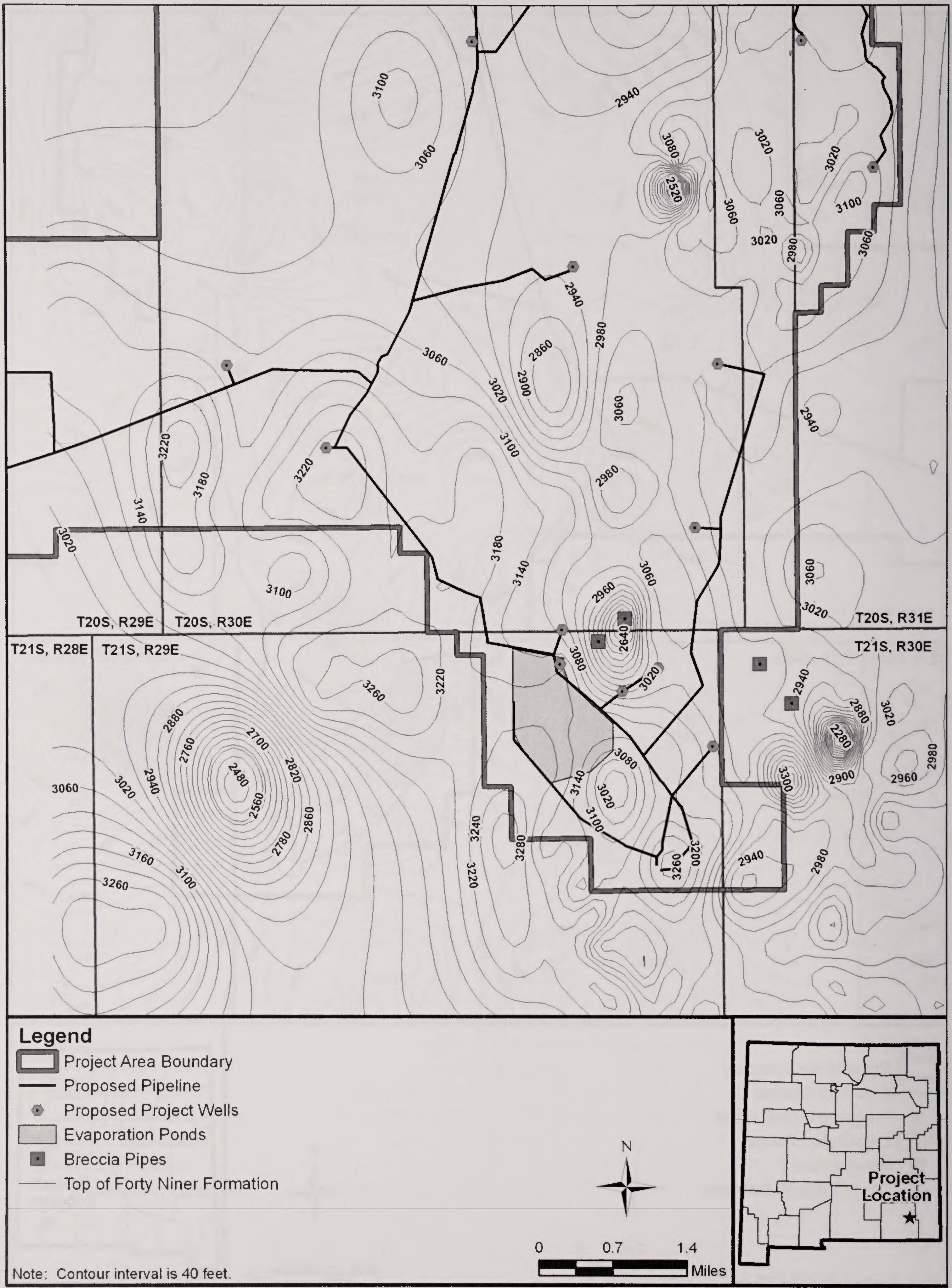


Figure 3.3-6. Top of Forty-niner Member, Rustler Formation in the Rustler North and South Areas

The Culebra Dolomite member is approximately 24 feet thick, dipping to the northeast at 80 to 120 feet per mile, and yielding water at 49 gpm (Intrepid Potash Inc./Shaw 2008a). **Figure 3.3-4** is a structure contour map drawn on the top of the Culebra. The Culebra dips to the northeast and does not show influence from the collapse associated with the breccia pipes that is evident in the Dewey Lake Red Beds and on top of the Forty-niner member.

The total thickness of the Tamarisk encountered during borings in the project area was 84 feet. No water was encountered in the Tamarisk (Intrepid Potash Inc./Shaw 2008a)

The Magenta Dolomite member ranges from 29 to 37 feet thick and averages 31.7 feet thick. Fractures in the dolomite contain chlorite and calcite. The unit dips to the northeast at about 85 feet per mile in the Rustler South area. South of this area, the dip is to the southeast at 155 feet per mile. There is water in the Magenta and the unit acts as a confined aquifer due to the limitations of the overlying Forty-niner member. Protection from the Dewey Lake Red Beds has prevented dissolution of the Forty-niner and the Tamarisk. Effectively, the Magenta has not collapsed or formed blocks of breccia as it has in Nash Draw. Water yields in most of the recent borings were less than 3 gpm. One boring had a yield of around 100 gpm in a fracture zone at a depth of 371 feet, and one well approximately 1,000 feet south of the Rustler South area yielded water at a rate of 200 gpm at a depth of 387 feet. **Figure 3.3-5** shows the structure contour on the top of the Magenta. The Magenta does not show influence from the collapse associated with the breccia pipes that is evident in the Dewey Lake Red Beds.

The Forty-niner member of the Rustler consists of an upper anhydrite layer ranging from 21 to 38 feet thick The lower anhydrite layer is 11 to 17 feet thick (Intrepid Potash/Shaw 2008a). There is no water in the Forty-niner member.

Hydrogeology

The groundwater levels in the Magenta and Culebra members in the project area documented in December 2007 are shown in **Figure 3.3-7**. Well IP-WW-002 produces from the Culebra and well IP-WW-007 in the northern area of Rustler South produces from the Dewey Lake Red Beds. Groundwater in the Magenta generally flows to the southeast toward Nash Draw at a gradient of approximately 0.005 feet per feet. The aquifer in the Magenta Dolomite is confined and potentiometric levels range from 24 to 70 feet above the top of the unit. One exception is well IP-WW-006, where the potentiometric surface is 255 feet above the top of the Magenta (Intrepid Potash Inc./Shaw 2008a).

For the Magenta in well IP-WW-001, the transmissivity based on a short-term single-well aquifer test appears to be around 2,200 to 2,700 feet^2 per day with a hydraulic conductivity of 75 to 92 feet per day (Intrepid Potash Inc./Shaw 2008a). Well IP-WW-001 had a flow rate of 90 gpm from a fracture at 371 feet below the ground surface. Short-term aquifer tests in fractured rock are not representative of the system because they tap only the water in the fracture and do not pump long enough to drain the fracture. The short-term test in this well suggests a high transmissivity but low storage capacity for the fracture system intercepted. A more representative analysis of the data might be the Moench fracture flow match yielding a transmissivity value of 1,363 feet^2 per day and a hydraulic conductivity for the fracture of about 47 feet per day. Fractures can produce high flow rates for short periods of time with considerable transmissivity.

For the Culebra in well IP-WW-002, fracture flow is also a possibility (Intrepid Potash Inc./Shaw 2008a) and the solution of Moench transmissivity of 13 feet^2 per day with an estimated hydraulic conductivity of 0.55 feet per day is possible.

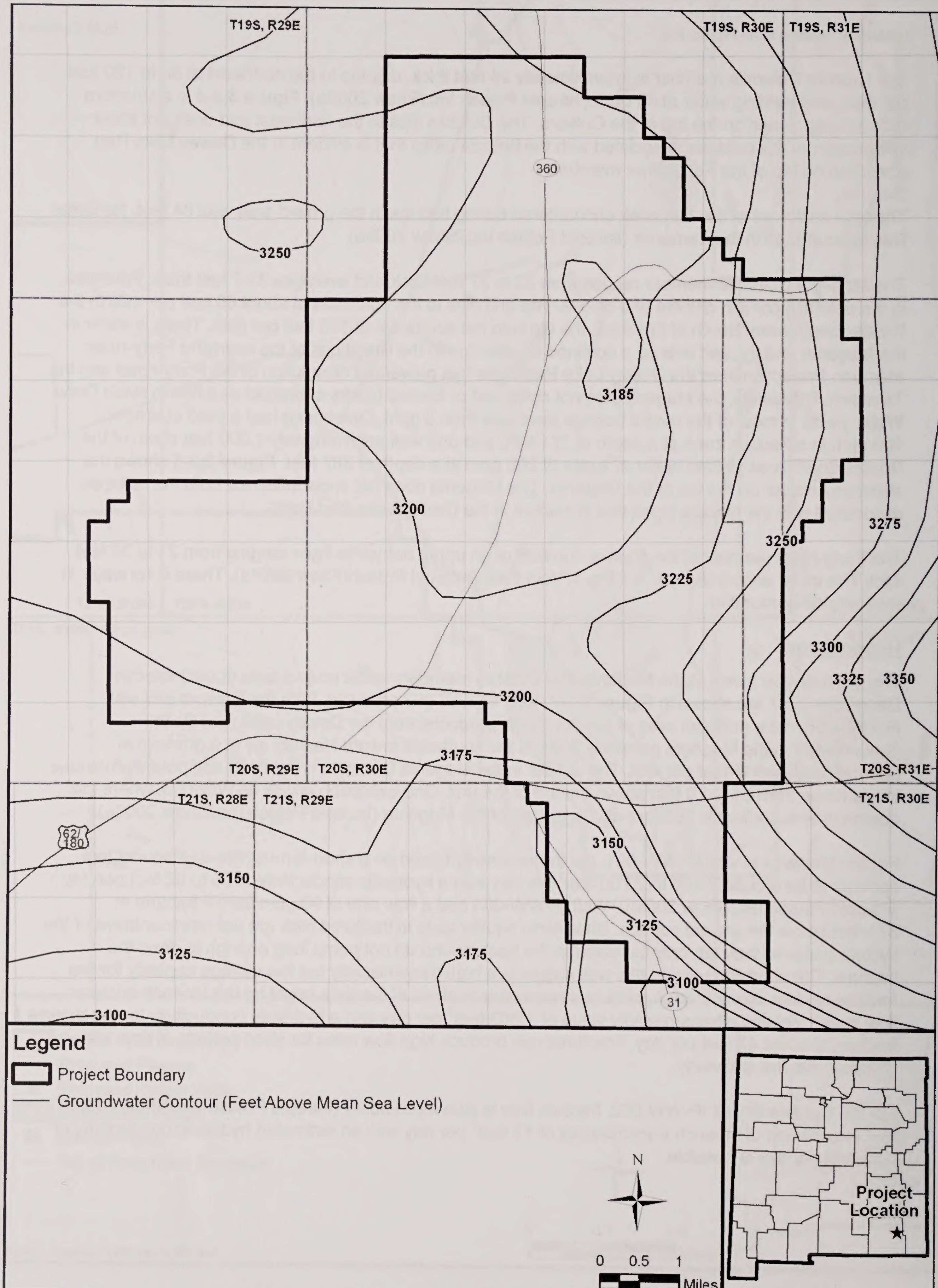


Figure 3.3-7. Groundwater Potentiometric Surface Contours in Project Area

Overall, the aquifer tests conducted by Intrepid and Shaw (2008a) suggest that fracture flow is dominant in the Magenta and Culebra members of the Rustler Formation in Rustler South. The short-term single well tests also suggest relatively low transmissivity, similar to the transmissivity found at WIPP, when compared to the extremely high values of transmissivity that characterize the Magenta and Culebra in Nash Draw. These values remain high but are not extreme in the Rustler South area because the Rustler has not undergone the dissolution of halite, conversion of anhydrite to gypsum, and the collapse of the formation that characterizes Nash Draw and the middle of Clayton Basin.

According to groundwater elevation contours (Geohydrology 1979) and ground surface elevations, groundwater near the project area is encountered within 40 feet below the ground surface in the center of Clayton Basin. It also is encountered in areas in Nash Draw just below the Maroon Cliffs and towards the lakes near the bottom of the draw. These locations, depicted in **Figure 3.3-8**, are areas where drawdown of the potentiometric surface might have a direct impact on surface resources.

Groundwater Chemistry

The seven monitoring wells installed in Rustler South have been sampled by Intrepid and Shaw (2008a) for water quality parameters. TDS increases to the northeast toward the area of breccia pipes in Section 2. Well IP-WW-007 is in the Dewey Lake Red Beds and its TDS value was not compared with the other TDS values in the Rustler. Values in the southwest corner of Section 2 are less than 10,000 mg/L and thus fall within the NMED guideline for protectable waters. Values in the northeast corner exceed 10,000 mg/L and exceed 100,000 mg/L. There is an abrupt increase in TDS starting around the middle of Section 2, northeast of well IP-WW-004.

Sulfate values in the southwest corner of Section 2 are below 3,000 mg/L. There is a sharp increase in sulfate starting northeast of well IP-WW-004 and values range from 4,800 to 7,000 mg/L. Well IP-WW-006, located in the far northeast corner of Section 2, and closest to the breccia pipes shows a drop in sulfate values to 2,700 mg/L. Chloride also increases sharply toward the northeast corner of Section 2. Values in the southwest part of Section 2 are below 500 mg/L. Within the central part of Section 2, values jump to 1,000 mg/L in well IP-WW-004, and in the northeast corner of Section 2 values for chloride range from 45,000 to 72,000 mg/L.

Calcium, magnesium, sodium, and potassium are elevated in the groundwater in the Rustler. The ratio of sodium to potassium decreases from southwest to northeast across the section. Water with a high ratio of potassium to sodium, or a low ratio of sodium to potassium, is indicative of potash refinery waste water and tailings water. North of the Section 2 area in the southern part of Clayton Basin, the Duval Mine operated in the 1950s and 1970s and discharged waste water to holding ponds and tailings (Geohydrology 1979). The discharge may be responsible for the sharp increase in chloride, TDS, and the drop in the sodium to potassium ratio in the northeast corner of Section 2. An alternative explanation may be that water from the Salado is moving upward along the ring fractures that surround the breccia pipes (Intrepid/Shaw 2008a). This would account for the elevated chloride and TDS, but not the low sodium to potassium ratio in the northeast corner of Section 2 near the breccia pipes.

Breccia Pipes Near Rustler South

Snyder and Gard (1982) evaluated many of the breccia pipes within the SPA and WIPP. The breccia pipe in Section 35, T20S, R30E was drilled by Snyder and Gard (1982), which revealed 1,981 feet of brecciated rock consisting of drown-dropped, folded, brecciated Santa Rosa, Dewey Lake Red Beds, Rustler Formation units, and Salado Formation.

The breccia pipe is relatively impermeable, with low flow potential based on drill stem tests (Snyder and Gard 1982). The pipe is surrounded by a zone of fractured rock and was created by cavern collapse in the underlying Capitan Limestone. Water may have moved upward from the Capitan Limestone to cause the dissolution of the evaporite units in the Rustler evident around the pipe (Snyder and Gard 1982).

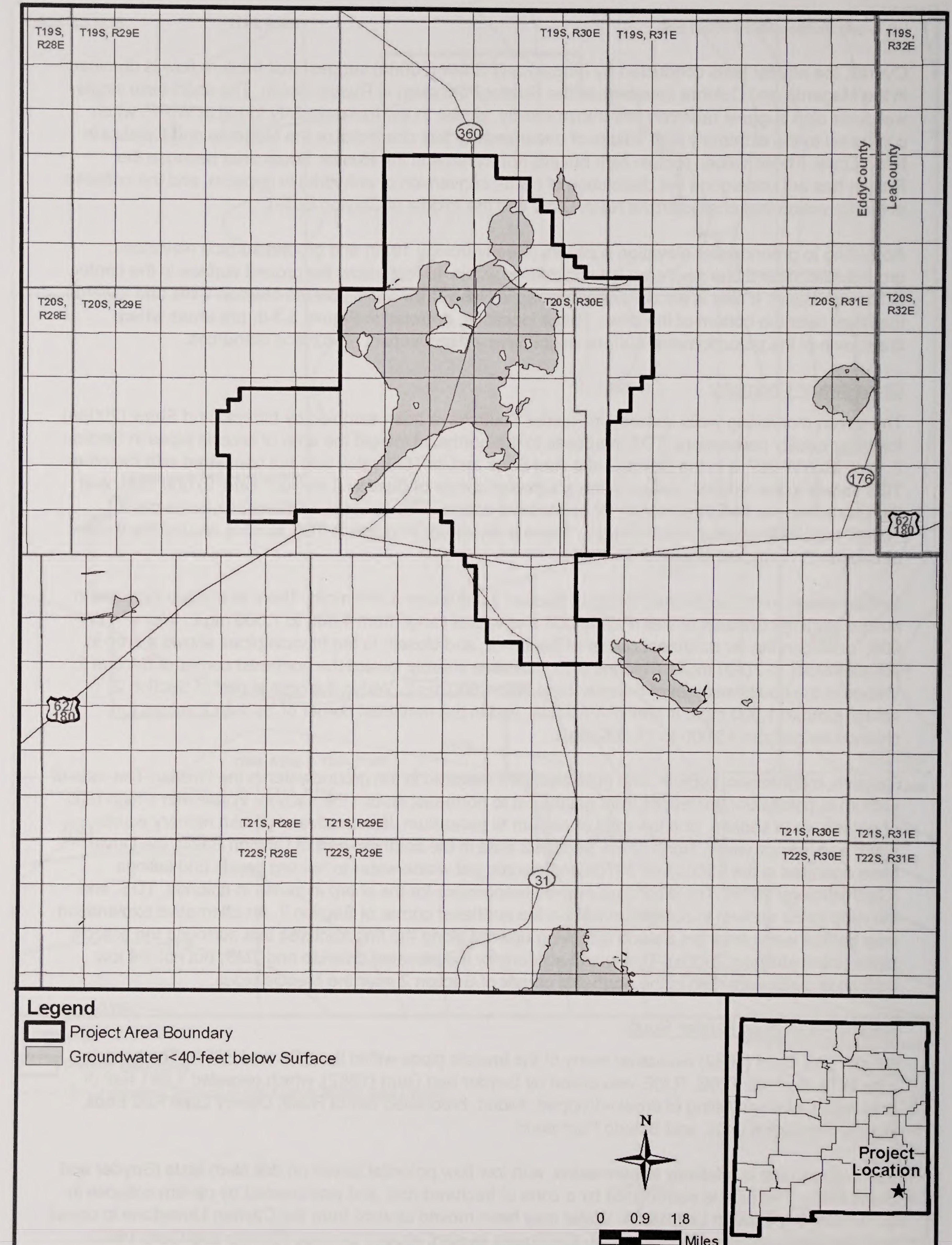


Figure 3.3-8. Top of Groundwater Surface within 40 Feet of Ground Level

Rustler Formation Near Rustler North

In the Rustler North area, the Rustler Formation layers that are separate in the Rustler South area have collapsed into one hydrologic unit and function as one aquifer due to dissolution of layers between. The aquifer is approximately 400 feet deep with a high flow potential due to the depth and hydraulic connection between the layers. Recent water tests of the former PCA wells that are currently unused indicate that there are relatively high levels of lead (approximately 0.3 mg/L) in these wells (American West Analytical Laboratories 2010). As a means of comparison, the EPA identifies an action level for lead in drinking water to be 0.015 mg/L. If drinking water exceeds the action level, steps must be taken to treat the water or the system to protect human health.

Units Above the Rustler Formation

The units above the Rustler are the Caliche and Alluvial Sand, the Gatuña Formation, the Santa Rosa Formation, and the Dewey Lake Red Beds. Water from the Dewey Lake Red Beds was found only in one boring, IP-WW-007. Well IP-WW-007 in the Dewey Lake Red Beds encountered an unconfined water body with an approximate transmissivity of 61 feet^2 per day and a corresponding hydraulic conductivity of 0.77 feet per day. A vertical pumping test between IP-WW-006 (Magenta) and IP-WW-007 (Dewey Lake) did not show any interaction between the two formations, probably because of the intervening dry Forty-niner member of the Rustler.

3.3.2.3 SPA Water Balance

Developing a water balance for the SPA is difficult to execute due to the movement of water through the aquifers that lie above the Salado Formation. Geohydrology Associates, Inc. were the first to attempt finding a water balance for the SPA (Geohydrology 1978).

As part of their assessment, Geohydrology developed a water balance for Clayton Basin and Nash Draw that accounted for:

- The influx of refinery discharge into the Rustler Formation.
- The rise in surface water levels from 1973 to 1978.
- The increase in brine ponds and natural pond surface areas due to refinery discharge.
- The rise in groundwater levels.

The water balance estimate of Geohydrology (1978) was focused on the discharge of refinery waste water to spoil piles and brine ponds in the “Carlsbad Potash District,” which encompassed the western SPA.

The water balance assessment for the WIPP project was developed for the region from the Pecos River to WIPP and east to the San Simon Swale by Hunter (1985). This water balance estimate relied on the work of Geohydrology (1978) for the western SPA. It also incorporated an assessment of the Pecos River, and an estimate for the loss of groundwater through the San Simon Swale. Recharge to the Ogallala Formation in the eastern part of the regional domain was not included because the study focused on aquifers between the Salado and the Ogallala formations. As a result of the larger area studied by Hunter (1985), the water balance estimates differed from Geohydrology’s estimates (1978).

Both of these approaches have their merits. The work of Geohydrology (1978) was detailed in its estimate of evapotranspiration from plants and evaporation from brine ponds. It involved field measurements and data from the operating potash refineries. Geohydrology’s studies only focused on Clayton Basin and Nash Draw. Hunter (1985) provides a regional look at water flows, which is more applicable to a groundwater model that encompasses more than just the SPA. Both of these water balances were considered and combined to produce a water balance for use in the groundwater model developed for the proposed project.

3.3.2.4 Summary of Groundwater in the Project Area

The hydrology of the SPA and the surrounding area is complex and varied. Clayton Basin and Nash Draw are both collapse features with different hydraulic characteristics. Clayton Basin is a closed hydrologic system and Nash Draw is a major groundwater sink drawing water from the Quahada Ridge area to the west and the WIPP area to the east. Nash Draw is an open system with discharge to the Pecos River. The Pecos River and its associated alluvial aquifer are in hydraulic communication and provide a major source of water for irrigation in Eddy County. The Rustler Formation at WIPP contains confined aquifers in the Magenta and Culebra members that are probably not in hydraulic communication, which is likely true for the Rustler Formation in the project area. In Nash Draw and Clayton Basin, dissolution of halite in the Rustler Formation and collapse have resulted in the entire Rustler acting as a single aquifer. There is considerable evidence that, in both Clayton Basin and Nash Draw, there is hydraulic communication between the members of the Rustler and between all aquifers overlying the Salado (Mercer 1983; Geohydrology 1978).

Some key points relative to the water balance of the SPA and adjacent areas are:

- Precipitation recharge to groundwater is about 3 percent of precipitation.
- Precipitation recharge for the SPA is about 28,000 acre-feet per year; Precipitation recharge for a larger area from the Pecos River to the San Simon Swale is about 44,000 acre-feet per year.
- Clayton Basin is a closed basin receiving about 16,000 acre-feet of groundwater recharge per year. Some of this is evapotranspired by natural ponds, lakes, and associated plants.
- Nash Draw is a groundwater sink open to the south with groundwater flow to the Pecos River. Flow to the Pecos is around 323 to 387 acre-feet per year based on estimates by Geohydrology (1978) and Hunter (1985).
- Precipitation recharge to Nash Draw is around 7,600 to 8,300 acre-feet per year. This recharge to groundwater must find its way to the Pecos River, suggesting that flow to the Pecos may be greater than previously estimated.
- The Pecos River is a major source for irrigation water. Irrigation return to the Pecos is about one-third of water withdrawn for irrigation. Consumptive loss of water is around 50 to 58 percent.
- The WIPP area has a distinct hydrologic system that is not found in either Nash Draw or Clayton Basin. The Rustler is intact and the Magenta and Culebra members are separate confined aquifers with distinctly different potentiometric surfaces. Groundwater flow is west to Nash Draw.
- Refinery discharge ponds leak and seep about 60 to 70 percent of the discharge to groundwater. This leads to a rise in groundwater levels near the ponds and an increase in the surface area of nearby natural ponds. Discharge by refineries directly to natural ponds, like in Clayton Basin and Salt Lake from 1950 to the 1980s, resulted in increased evaporation from the ponds due to the larger surface area. Water balance estimates by Hunter (1985) and Geohydrology (1978) suggest that refinery discharge to ponds is either lost by evapotranspiration or results in a rise in groundwater levels.
- Under natural conditions where there is no potash refinery discharge, rangeland plants take up 96 percent of precipitation and one percent is held as soil moisture (Geohydrology 1978). The 3 percent that becomes groundwater recharge is either lost by increased evapotranspiration in closed basins (Clayton Basin) due to a rise in water levels or natural pond surface area, or it flows out of the system toward the Pecos River (via Nash Draw).

3.3.2.5 Caprock Area Hydrogeology and Groundwater Chemistry

Northeast of the SPA, the Caprock area is underlain by the High Plains Aquifer, which has a large areal extent, underlying portions of South Dakota, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, Texas, and New Mexico. The predominant water source in Lea County is the Ogallala Aquifer, which provides water for municipal, domestic, irrigation, and other uses (NMOSE 1999). The High Plains aquifer consists mainly of the Tertiary-aged Ogallala Formation consisting of clays, silts, sands, gravels, and caliches. There are localized areas with Quaternary alluvial dune sands that overlie the Ogallala Formation and constitute part of the aquifer.

Depth to water of the Ogallala Aquifer in the Caprock area ranges from approximately100 feet in the southeast near Buckeye to 150 feet or greater to the west towards Maljamar. The saturated thickness of the aquifer increases from approximately 100 feet near Maljamar to 150 feet or greater near Buckeye. Groundwater flow is generally to the southeast (NMOSE 1999; Tillery 2008).

According to the Lea County Regional Water Plan (NMOSE 1999), water from the Ogallala Aquifer in Lea County is consistently good quality, typically ranging from 300 to 415 mg/l, which is high but acceptable for potable water. Fluoride concentrations are high but acceptable, chloride concentrations are moderate, and sulfate concentrations are low.

3.3.2.6 Groundwater Use

Groundwater use was investigated through searches of the NMOSE water rights database. Groundwater use in the project area is minimal. Half of the wells are designated for mining, oil, and natural resource development. **Table 3.3-3** summarizes the existing permitted wells in the project area.

Table 3.3-3 Summary of Groundwater Wells in Project Area

Well Use	Count
Domestic	1
Livestock	4
Prospecting or Development of Natural Resources	4
Mining or Milling or Oil	1
Total	**10**

Groundwater use in the Caprock area is greater due to larger populations, a much more extensive and high-yielding aquifer, and few other suitable water sources. The total water rights appropriation for all of Intrepid's Caprock wells is over 16,000 acre-feet per year. Ogallala Aquifer available water levels have been in decline since the mid-1900s as groundwater demand increased and storage has been depleted. The estimated annual recharge to the Ogallala Aquifer in Lea County is between 37,500 to 75,000 acre-feet. From 1995 to 1998, it is estimated that 14 million acre-feet of water was recoverable for use from the Ogallala Aquifer in Lea County (NMOSE 1999). Diversions from Lea County groundwater sources, predominantly from the Ogallala Aquifer, were 178,522 acre-feet of water in 1998 (NMOSE 1999) and 185,952 acre-feet in 2005 (NMOSE 2005).

The total annual water rights appropriation for all of Intrepid's Caprock wells is 16,090 acre-feet, or approximately 9 percent of the total county water usage. In 2009, Intrepid used 5,051 acre-feet, or 31 percent, of its permitted Caprock area water. Intrepid's Caprock water rights are recorded at the NMOSE with the following file numbers:

- L-2675 through L-2680-Combined (8,330 acre-feet)
- L-2724 (2,410 acre-feet)
- L-4247-A (1,400 acre-feet)
- L-1880 through L-1884-combined-enlarged (3,950 acre-feet)

Similar to the project area, the majority of designated uses for Caprock area water are for oil, mining, and industrial uses. **Table 3.3-4** summarize the well numbers and uses in the Caprock area within 3 miles of Intrepid's well fields.

Table 3.3-4 Summary of Groundwater Wells within 3-mile Radius of Intrepid's Caprock Wellfields

Well Use	Count
Commercial	9
Domestic	32
Exploratory	19
Industrial	51
Irrigation	3
Mining & Refining	14
Oil Well Drilling	212
Secondary Recovery Oil Well	11
Livestock	22
Total	**373**

3.4 Soils

A variety of data sources were used to identify the baseline soil characteristics in the project area. Information on Major Land Resource Areas and Soil Types was obtained from NRCS literature or databases, including the Land Resource Regions and Major Land Resource Areas of the U.S., the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (NRCS 2006) and the Soil Survey Geographic Database (SSURGO). Soil baseline characterization for the project area is based on SSURGO review and analyses. SSURGO is the most detailed level of soil mapping done by the U.S. Department of Agriculture (USDA) NRCS. The SSURGO database for Eddy County, New Mexico (NRCS 2008a) is the source for the soils data in this section.

3.4.1 Major Land Resource Areas

The proposed project boundary lies within Major Land Resource Area (MLRA) 70D, The Southern Desert Foothills (NRCS 2006), which is in the southern part of the Sacramento Section of the Basin and Range Province of the Intermontane Plateaus. The Sacramento Section is characterized by nearly level to rolling or steep limestone hills with intermittent drainageways. The soils are derived from limestones, sandstones, shales, and dolomites. The dominant soil orders in this MLRA are aridisols and mollisols. Aridisols are well developed soils that have a very low concentration of organic matter and form in an arid or semi-arid climate. In contrast, mollisols are fertile soils with high organic matter and a nutrient-enriched, thick surface. The soils in the MLRA are well to excessively drained and range from shallow (0 to 20 inches) to very deep (60 or more inches) with areas of dune land, gypsum land, and rock outcrop.

3.4.2 Soil Types and Limitations in Project Area

The project area contains 20 soil map units, each of which contain one or two components. Soil textures range from sands to clay loams. Most of the soils in the project area are deep to very deep, well-drained, and formed from alluvial or residual materials derived from sedimentary rocks. The soil series is the most specific category of the national soil classification system, commonly used to designate soil map units. Soil series describe soils that have similar chemistry, physical properties, and perform similarly for land use purposes. Following is a brief description of each of the soil series present within the project area.

- Reeves series: very deep, well drained, moderately permeable soil that formed in calcareous and gypsiferous fine textured alluvium derived from gypsum beds. These soils are on hillslopes, plateaus, and basin floors with slopes ranging from 0 to 9 percent. Reeves soils are moderate to highly saline.
- Kermit series: very deep, excessively drained soil that formed in eolian sands. Kermit soils are on sandy plains with slopes of 0 to 12 percent.
- Bippus series: very deep, well drained, moderately permeable soils that formed in loamy alluvial sediments of the Ogallala Formation of Miocene-Pliocene age. These soils are on nearly level to very gently sloping floodplains or draws with slopes of 0 to 2 percent.
- Berino series: very deep, well drained soil that formed in mixed alluvium, which has repeatedly been reworked by wind. These soils are on sandy plains, fan piedmonts, piedmont slopes, and valley floors with slopes of 0 to 7 percent.
- Simona series: shallow to very shallow, well drained soil that formed in calcareous sandy sediments over fractured indurated caliche. Simona soils are on upland plains, mesa tops, and low ridges and have slopes of 0 to 10 percent.
- Pajarito series: very deep, well drained soils that formed in sandy to moderately sandy mixed sediments from mixed sources. These soils are typically on plains, bajadas, and alluvial fans with slopes of 0 to 15 percent, dominantly 1 to 3 percent.
- Potter series: very deep, well drained, moderately slowly permeable soil that formed in calcareous sediments of fractured and highly weathered calcrete derived mainly from the Ogallala Formation of Miocene-Pliocene age. Potter soils are on very gently sloping to steep draws, scarps, or valley sides with slopes of 1 to 30 percent.
- Largo series: very deep, well drained soils that formed in loamy calcareous alluvium derived from redbed formations of Jurassic, Triassic, Permian and Pennsylvanian age. These soils are on channeled valley bottom terraces, alluvial fans and piedmont slopes of 0 to 5 percent. They have moderate to moderately slow permeability.
- Reagan series: very deep, well drained, moderately permeable calcareous soils that formed in calcareous loamy materials. These nearly level to gently sloping upland soils are on broad flats, filled valleys, and fans with slopes of 0 to 3 percent. Reagan soils are moderate to highly saline.
- Tonuco (very shallow to shallow), Cacique (moderately deep to a cemented layer), and Likes (very deep) series occur in the project area but to a lesser extent along with areas of dune land, gypsum land, rock land, mined land, and stony and rough broken land.

The soil map unit symbols, soils series and component names, slope range, acreage, and some key characteristics derived from the SSURGO database are listed in **Table 3.4-1**.

Soil characteristics such as susceptibility to erosion and the potential for revegetation are important to consider when planning for construction activities and stabilization of disturbed areas. These hazards or limitations for use are a function of many physical and chemical characteristics of each soil, in combination with the climate and vegetation. **Table 3.4-2** and **Table 3.4-3** summarize important soil characteristics to be considered when evaluating the effects of surface-disturbing activities. Explanations of the meanings of each column follow the table.

Table 3.4-1 Relevant Characteristics of Soils in the Project Area

MUID[1]	Map Unit Name	Component Name	Comp %	Slope	Wind Erosion[2]	Water Erosion[3]	Topsoil Suitability	Limiting Factors[4]	Map Unit Acres
BA	Berino loamy fine sand, 0 to 3 percent slopes	Berino	100	0-3	Severe	Not Severe	Good	C, OM, E	575
BB	Berino complex, 0 to 3 percent slopes, eroded	Berino	60	0-3	Severe	Not Severe	Good	C, OM, E	2,435
BB	Berino complex, 0 to 3 percent slopes, eroded	Pajarito	25	0-3	Severe	Not Severe	Fair	C, OM, E	
CA	Cacique loamy sand, 0 to 3 percent slopes, eroded	Cacique	100	0-3	Severe	Not Severe	Fair	CP, D, OM, E	256
ML	Mined land	Mined land	100	0-50	N/A	N/A	Not rated	NR	1,109
GA	Gypsum land	Gypsum land	100	0-75	N/A	N/A	Not rated	NR	2,065
KM	Kermit-Berino fine sands, 0 to 3 percent slopes	Berino	35	0-3	Severe	Not Severe	Good	C, OM, E	7,122
KM	Kermit-Berino fine sands, 0 to 3 percent slopes	Kermit	50	0-3	Severe	Not Severe	Poor	D, OM, R, SD, E	
LA	Largo loam, 1 to 5 percent slopes	Largo	100	1-5	Moderate	Severe	Good	OM, E	1,331
LS	Likes loamy fine sand, 1 to 5 percent slopes	Likes	100	1-5	Severe	Not Severe	Fair	D, OM, SD, E	73
PA	Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	Pajarito	100	0-3	Severe	Not Severe	Good	OM, E	1,498
PD	Pajarito-Dune land complex, 0 to 3 percent slopes	Dune land	45	-		Not Severe	Not rated	NR, OM	
PD	Pajarito-Dune land complex, 0 to 3 percent slopes	Pajarito	45	0-3	Moderate	Not Severe	Good	OM	1,609
PS	Potter-Simona complex, 5 to 25 percent slopes	Potter	80	5-25	Low	Not Severe	Poor	C, CP, D, OM, R, S	1,776
PS	Potter-Simona complex, 5 to 25 percent slopes	Simona	15	5-10	Moderate	Not Severe	Poor	CP, D, OM, R	
RA	Reagan loam, 0 to 3 percent slopes	Reagan	100	0-3	Low	Severe	Fair	C, OM, Na, E	284
RG	Reeves-Gypsum land complex, 0 to 3 percent slopes	Gypsum land	30	0-3	N/A	Not Severe	Not rated	NR	
RG	Reeves-Gypsum land complex, 0 to 3 percent slopes	Reeves	55	0-1	Moderate	Severe	Fair	C, D, OM, Na, E	13,021
RO	Rock land	Rock land	100	-	N/A	Not Severe	Not rated	NR	439
SA	Simona sandy loam, 0 to 3 percent slopes	Simona	95	0-3	Moderate	Severe	Poor	CP, D, OM	169

Table 3.4-1 Relevant Characteristics of Soils in the Project Area

MUID[1]	Map Unit Name	Component Name	Comp %	Slope	Wind Erosion[2]	Water Erosion[3]	Topsoil Suitability	Limiting Factors[4]	Map Unit Acres
SG	Simona gravelly fine sandy loam, 0 to 3 percent slopes	Simona	95	0-3	Moderate	Not Severe	Poor	CP, D, OM, R	218
SM	Simona-Bippus complex, 0 to 5 percent slopes	Bippus	30	0-5	Moderate	Not Severe	Fair	C, CL	
SM	Simona-Bippus complex, 0 to 5 percent slopes	Simona	55	0-3	Moderate	Not Severe	Poor	CP, D, OM, R	2,881
SR	Stony and Rough broken land	Stony and rough broken land	100	-	N/A	N/A	Not rated	NR	836
TF	Tonuco loamy fine sand, 0 to 3 percent slopes	Tonuco	100	0-3	Severe	Not Severe	Poor	CP, D, OM, SD, E	402
TN	Tonuco loamy fine sand, 0 to 3 percent slopes, eroded	Tonuco	100	0-3	Severe	Not Severe	Poor	CP, D, OM, SD, E	356
								Total Acres	38,453

[1] Map Unit Identification.

[2] Wind erosion hazard class based on Wind Erodibility Group Rating.

[3] Water erosion potential determined by Kw >0.28.

[4] Limiting Factors:

BR = Depth to Bedrock
C = High Carbonate Content
CL = Too Clayey
CP = Cemented Pan
D = Droughty
E = Erosion
NA = Salinity
NR = Not Rated
OM = Low Organic Matter
R = Rock Fragments
S = Slope
SD = Too Sandy

Source: NRCS 2008a.

Table 3.4-2 Summary of Soil Limitations in the Project Area

Soil Limitation	Good (ac./%)		Fair (ac./%)		Poor (ac./%)		Not Rated (ac./%)	
Wind Erosion	1,705	4	3,806	10	11,284	33	17,570	51
Water Erosion	30,356	79	—	0	—	0	4,009	12
Road Construction	9,907	26	14,516	38	864	3	9,078	26
Shallow Excavations	7,920	21	6,301	18	11,066	32	9,078	26
Potential for Revegetation	—	0	2,779	8	23,232	68	8,354	24
Topsoil Suitability	8,082	21	9,248	27	7,958	23	9,078	26

Source: NRCS 2008a.

Table 3.4-3 Proposed and Existing Pipeline Corridors

Soil Limitation	Good (ac./%)		Fair (ac./%)		Poor (ac./%)		Not Rated (ac./%)	
Existing Caprock Pipelines								
Wind Erosion	-	0%	8	1%	139	21%	168	25%
Water Erosion	316	47%	-	0%	-	0%	-	0%
Road Construction	244	37%	127	19%	15	2%	13	2%
Shallow Excavations	10	2%	73	11%	251	38%	3	<1%
Potential for Revegetation	-	0%	2	<1	333	50%	3	<1%
Topsoil Suitability	-	0%	46	7%	36	5%	234	35%
Proposed Pipeline								
Wind Erosion	<1	<1	119	18%	102	15%	2	<1
Water Erosion	220	33%	-	0%	-	0%	4	1%
Road Construction	24	4%	10	2%	-	0%	2	<1
Shallow Excavations	7	1%	49	7%	167	25%	2	<1
Potential for Revegetation	-	0%	3	<1	218	33%	4	1%
Topsoil Suitability	31	5%	20	3%	171	26%	2	<1

Water erosion is the detachment and movement of soil by water. Natural erosion rates depend on inherent soil properties, slope, soil cover, and climate. Approximately 23 percent of the soils within the project area are highly erodible to water. Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks (Soil Quality Institute 2001). Wind erodible soils comprise approximately 29 percent of the project area. The occurrence of wind erodible soils is illustrated in **Figure 3.4-1**.

Soil limitations within the project area related to road construction and use include soil strength issues, slope, flooding frequency, soil stickiness, and sand content. Only 2 percent of the project area would have potential issues related to flooding. Approximately 11 percent of the project area is identified as having high sand content and 18 percent of the project area has slopes in the range of 6 to 12 percent. About 22 percent of the project area has soils with stickiness limitations. Approximately 27 percent of the project area has potential soil strength limitations. In total, 64 percent of the project area has at least one soil limitation for construction of natural surface roads.

Soil limitations within the study area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile. Only 2 percent of the project area would have potential issues related to flooding. Approximately 4 percent of the soils in the project area have a thick cemented pan (40 to 60 inches thick) while 6 percent have a thin cemented pan (20 to 40 inches thick). Slopes of 8 to 15 percent occur in approximately 17 percent of the project area. Approximately 22 percent of project area soils have large stones in the soil profile. Approximately 47 percent of soils in the project area have limitations associated with cutback caving. In total, 67 percent of the project area has at least one soil limitation related to shallow excavations. The distribution of soils with limitations associated with shallow excavation in the project area is illustrated in **Figure 3.4-2**. Approximately 65 percent of the existing pipeline corridors have poor soil limitations related to shallow excavations. However, the soil profile in this area was previously disturbed by prior excavation. The original soil profile may have been modified such that the limitations have been reduced or removed in relation to large stones or a cemented pan. Approximately 25 percent of the proposed new Caprock pipeline corridor has poor soil limitations related to shallow excavations.

Topsoil suitability describes soil material used to cover an area for the establishment and maintenance of adapted vegetation. Soil properties that are used to rate the soil as topsoil are those that affect plant growth; the ease of excavation, loading, and spreading; and the reclamation of the borrow area. The physical and chemical soil properties and qualities that influence plant growth include the presence of toxic substances, soil reaction, and those properties that are inferred from the soil texture, such as the available water capacity, and fertility. The properties that influence the ease of excavation, loading, and spreading are the amount of rock fragments, slope, depth to the water table, soil texture, and thickness of suitable material. The properties that influence the reclamation of the borrow area are the slope, depth to the water table, amount of rock fragments, depth to rock, and the presence of toxic material. The existing and proposed new Caprock pipeline corridors would require the salvage and replacement of topsoil. Approximately 9 percent of the existing pipeline corridors contain soils with poor topsoil suitability. Approximately 26 percent of the proposed new Caprock pipeline corridor contain soils with poor topsoil suitability.

Soils with low revegetation potential have chemical characteristics such as high salts, sodium, or pH that may limit plant growth. Saline soils affect plant uptake of water and sodic soils and often have drainage limitations. In addition, the success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils. The distribution of soils with characteristics that limit revegetation within the project area is displayed in **Figure 3.4-3**.

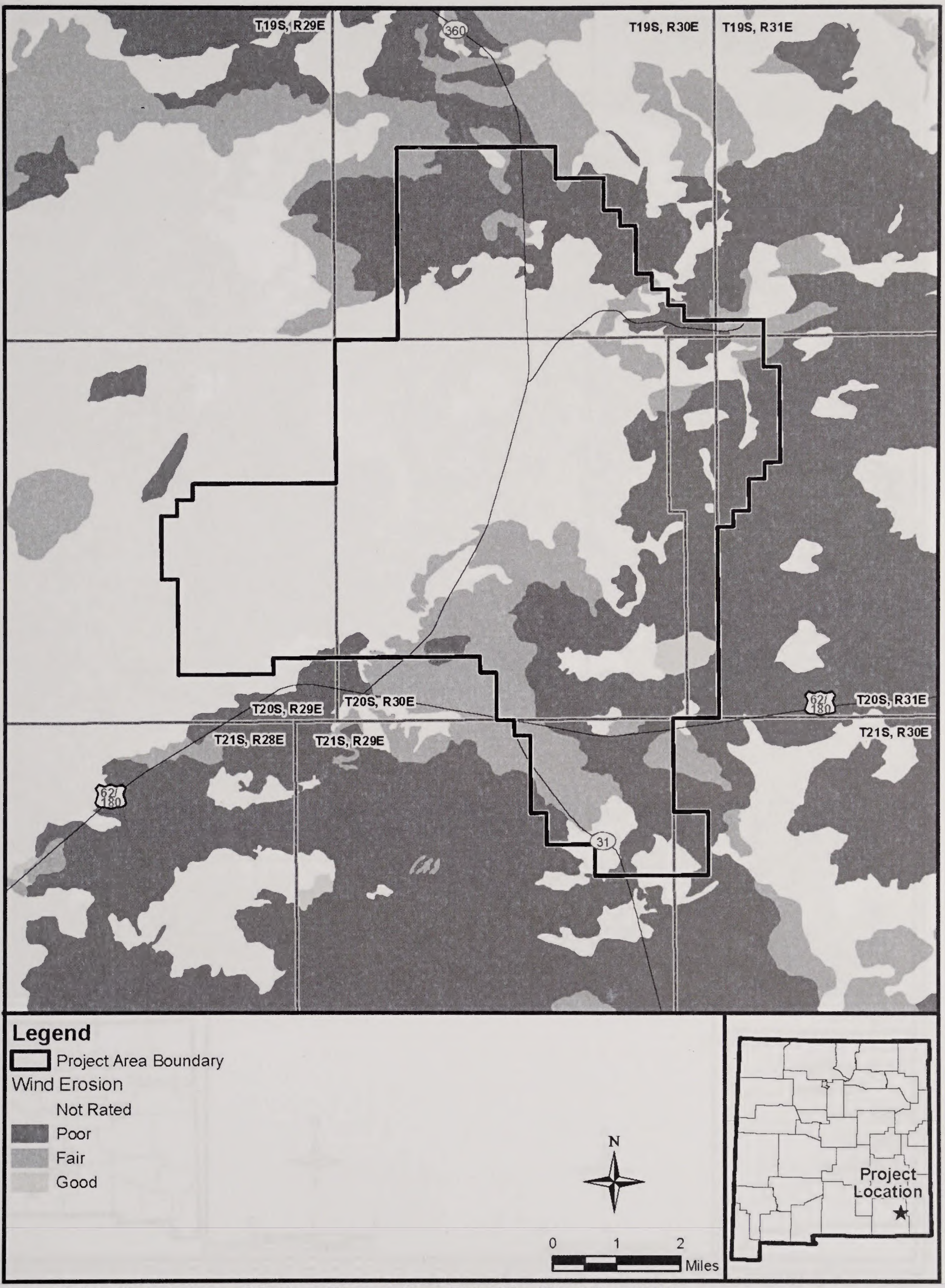


Figure 3.4-1. Distribution of Soils in Project Area Rated for Wind Erodibility

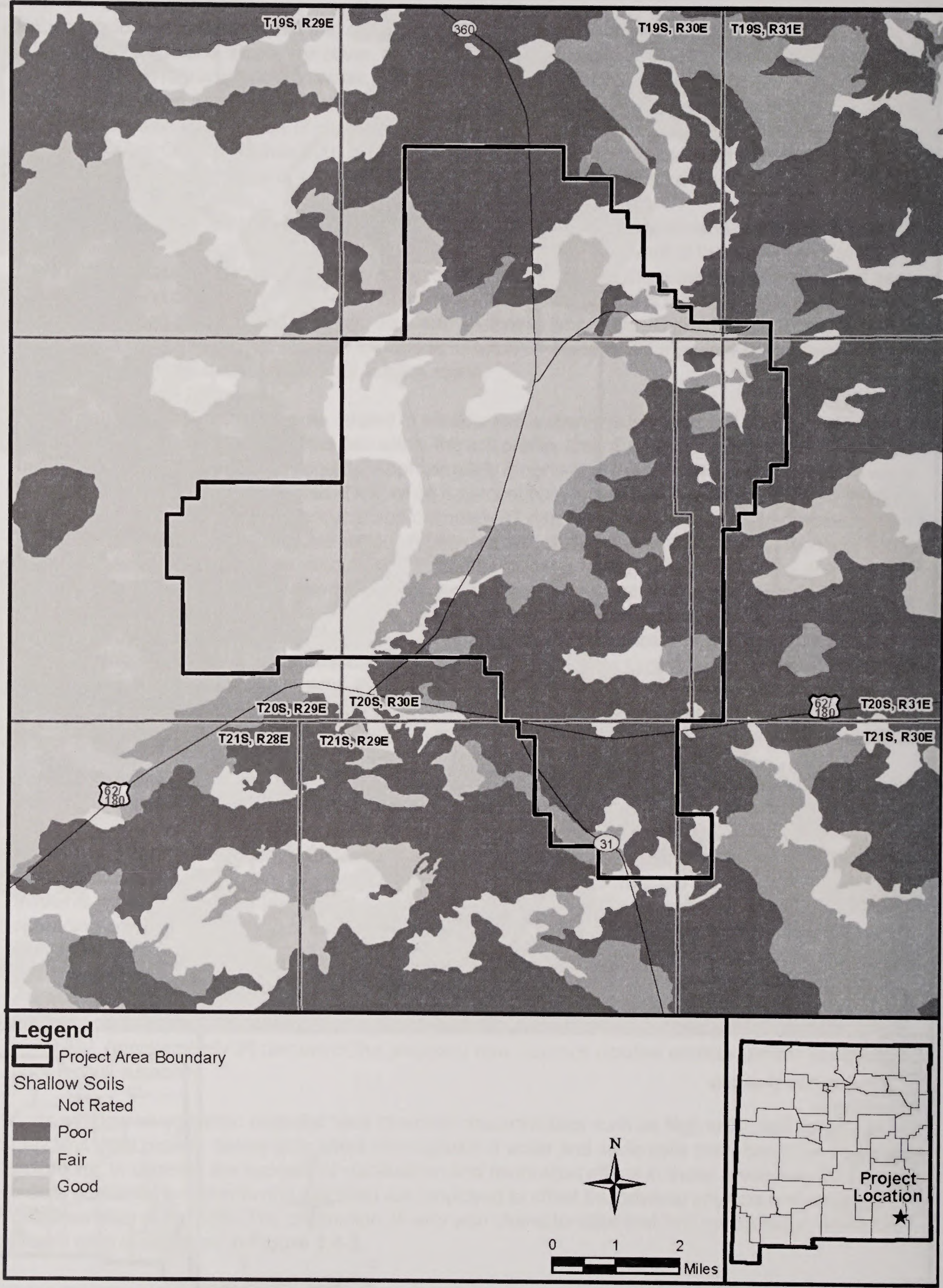


Figure 3.4-2. Distribution of Shallow Soils in Project Area

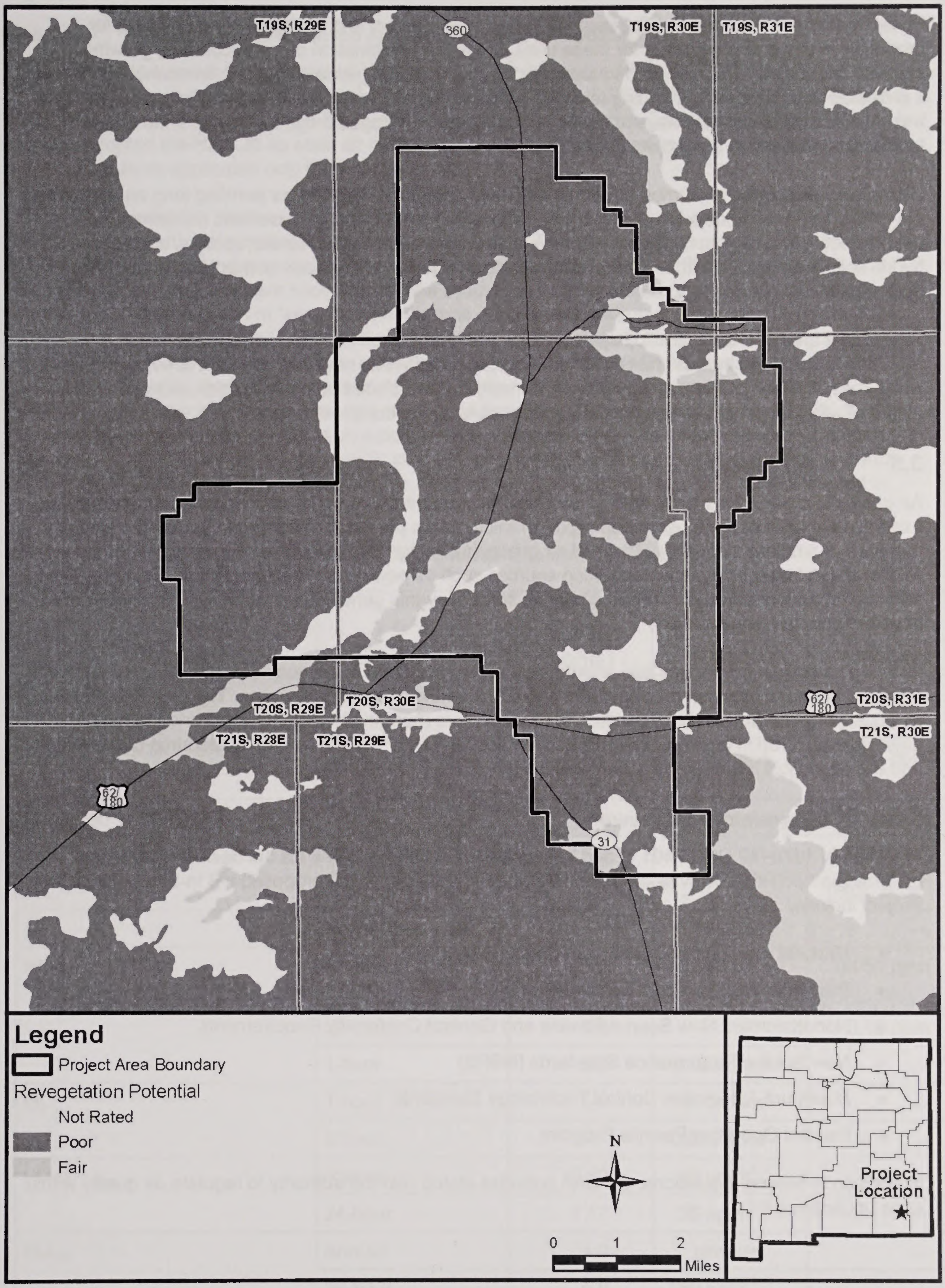


Figure 3.4-3. Distribution of Soils in Project Area by Revegetation Potential

Prime farmland is land that has the best combination of physical and chemical characteristics for producing crops and is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses. No prime farmland occurs within the project area.

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, riparian areas, wetlands, springs, and seeps. No hydric soils are mapped within the project area. However, due to the scale of mapping, small areas of hydric soils may not be captured.

The project area has been previously disturbed by mining and oil and gas activities. Environmental reports (OCD 2009a) indicate that spills of saline produced water have occurred within the project area, which may have increased the extent of saline soils in the surface horizon. However, this increased extent of saline soils may not be accurately quantified by the current soil survey.

3.5 Air Quality

Air quality in a given location is defined by pollutant concentrations in the atmosphere and generally is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Visibility also is a measure of ambient air quality. Regional air quality is affected by natural events such as windstorms and wildfires, and larger emissions generating sources such as power plants, large manufacturing facilities, and transportation activities in urban corridors. Natural events generally are short lived, lasting from several hours to several weeks.

Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect ambient air concentrations. The physical effects of air quality depend on the characteristics of the receptors (human or environmental) and the type, amount, and duration of exposure. This section describes the existing air quality resource of the region and the applicable air regulations that would apply to the Proposed Action and alternatives.

3.5.1 Regulatory Framework

The CAA of 1970 (42 USC 7401 et seq.) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA that are relevant to the proposed HB In-Situ Solution Mine Project include:

- National Ambient Air Quality Standards (NAAQS)
- Prevention of Significant Deterioration (PSD)
- Nonattainment New Source Review and General Conformity Requirements
- New Source Performance Standards (NSPS)
- Maximum Achievable Control Technology Standards
- Federal Operating Permits Program

In addition to federal regulations, the CAA provides states with the authority to regulate air quality within state boundaries.

3.5.1.1 National and New Mexico Ambient Air Quality Standards

The federal CAA and the amendments of 1990 require all states to control air pollution emission sources so that NAAQS are met and maintained, enforced by the USEPA (USEPA 2004). The CAA directs the USEPA to delegate primary responsibility for air pollution control to state governments. The State of New Mexico adopted the NAAQS as state air quality standards and has added more stringent ambient air quality standards applicable only to New Mexico.

The NAAQS establish maximum acceptable concentrations for oxides of nitrogen (NO_X), CO, sulfur dioxide (SO_2), particulate matter (PM) with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), PM with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), ozone (O_3), and lead (Pb). These pollutants are known as criteria pollutants. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, and against damage to animals, crops, other vegetation, and buildings. These standards represent the maximum allowable atmospheric concentrations that may occur without jeopardizing public health and welfare, and include a reasonable margin of safety. An area that does not meet the NAAQS is designated as a nonattainment area on a pollutant-by-pollutant basis. A list of the criteria pollutants regulated under the CAA for which specific concentration levels have been established, their currently applicable NAAQS, and State of New Mexico Ambient Air Quality Standards (NMAAQS) are listed in **Table 3.5-1**.

Table 3.5-1 National and New Mexico Ambient Air Quality Standards

Pollutant	Averaging Period	Significance Level[D] ($\mu g/m^3$)	NAAQS	NMAAQS
CO	8-hour	500	9 ppm (10 mg/m^3)[1]	8.7 ppm
	1-hour	2,000	35 ppm (40mg/m^3)[1]	13.1 ppm
Hydrogen sulfide (H_2S)	1-hour	1.0	—	0.010 ppm[A,1]
	1/2-hour	5.0	—	0.100 ppm[B]
	1/2-hour	5.0	—	0.030 ppm[C]
Pb	Rolling 3-month	—	0.15 $\mu g/m^3$	—
NO_2	Annual	1.0	0.053 ppm (100 $\mu g/m^3$)	0.050 ppm
	24-hour	5.0	—	0.10 ppm
	1-hour	5.0	0.100 ppm[2]	—
O_3	1-hour	—	0.12 ppm[3]	—
	8-hour	—	0.075 ppm[4]	—
$PM_{2.5}$	Annual	0.30	15 $\mu g/m^3$[3, 5]	—
	24-hour	1.17	35 $\mu g/m^3$[3, 6]	—
PM_{10}	Annual	1.0	revoked[7]	—
	24-hour	5.0	150 $\mu g/m^3$[3, 1]	—

Table 3.5-1 National and New Mexico Ambient Air Quality Standards

Pollutant	Averaging Period	Significance Level[D] (µg/m^3)	NAAQS	NMAAQS
Particulates (total suspended particulates [TSP])	Annual Geometric Mean	1.0	—	60 µg/m^3
	30-day	—	—	90 µg/m^3
	7-day	—	—	110 µg/m^3
	24-hour	5.0	—	150 µg/m^3
Sulfur Dioxide (SO$_2$)	Annual	1.0	Revoked[8]	0.02 ppm
	24-hour	5.0	Revoked[8]	0.10 ppm
	3-hour	25.0	0.50 ppm	—
	1-hour	—	0.075 ppm[9]	—

[A] For the state, except for the Pecos-Permian Basin Intrastate Air Quality Control Region (AQCR).

[B] For the Pecos-Permian Basin Intrastate AQCR.

[C] For within 5 miles of the corporate limits of municipalities within the Pecos-Permian Basin AQCR.

[D] Significance levels are listed in 20.2.72.500 NMAC.

[1] Not to be exceeded more than once per year.

[2] The 3-year average of the 98th percentile of the daily maximum 1-hour average is not to exceed this standard.

[3] (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is <= 1, as determined by Appendix H.
(b) The 1-hour NAAQS will no longer apply to an area 1 year after the effective date of the designation of that area for the 8-hour ozone NAAQS. The effective designation date for most areas is June 15, 2004 (40 CFR 50.9; see *Federal Register* of April 30, 2004 [69 FR 23996]).

[4] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

[5] To attain this standard, the 3-year average of the annual arithmetic mean PM$_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.

[6] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3.

[7] The annual PM$_{10}$ NAAQS of 50 µg/m^3 was revoked by USEPA on September 21, 2006; FR Volume 71, Number 200, 10/17/06.

[8] The 24-hour and annual SO$_2$ NAAQS was revoked by USEPA on June 22, 2010; 75FR35520.

[9] The 3-year average of the annual 99th percentile of the 1-hour daily maximum must not exceed this standard.

Source: New Mexico Environment Department-Air Quality Bureau (NMED-AQB) 2010a; USEPA 2010a.

There are eight Air Quality Control Regions (AQCRs) designated in New Mexico. The proposed project is located in Eddy County, which is part of the Pecos-Permian Basin ACQR 155. When the minor source baseline date has been triggered in AQCR 155, an increment analysis is required if the modeling significance levels for a designated pollutant are exceeded.

3.5.1.2 New Source Review

New Source Review (NSR) requires stationary sources of air pollution to get permits before starting construction. NSR also is referred to as construction permitting or pre-construction permitting. There are three types of NSR permitting requirements that a source may need to meet. The three types of NSR requirements are:

- PSD permits that are required for new major sources or existing major sources making a major modification in an attainment area
- Nonattainment NSR permits that are required for new major sources or existing major sources making a major modification in a nonattainment area
- Minor source (non-PSD) permits.

3.5.1.3 Prevention of Significant Deterioration

PSD regulations apply to proposed new or modified sources in an attainment area that have the potential to emit criteria pollutants in excess of predetermined de minimis values (40 CFR Part 52). PSD regulations restrict the degree of ambient air quality deterioration allowed. Allowable deterioration to air quality can be expressed as the incremental increase to ambient concentrations of criteria pollutants, or PSD increment. Increments for criteria pollutants are based on the PSD classification of the area. Class I designations allow the lowest amount of permissible deterioration by precluding development near designated areas. Class II areas are designed to allow for moderate, controlled growth, and Class III areas allow for heavy industrial use. However, no Class III areas have yet been defined in the United States.

Federal PSD Class I areas, which include certain national wilderness areas, national memorial parks, and national parks, are afforded the highest level of protection. Ambient air quality criteria that apply within Class I areas are the most stringent and include the regulation of air quality related values (AQRVs). Federal Land Managers (FLMs) are responsible for the management of PSD Class I areas. The nearest Class I areas are Carlsbad Caverns National Park (NP) approximately 32 miles (52 kilometer [km]) and the Guadalupe Mountains NP about 60 miles (97 km) southwest of the project area.

PSD Increment

A project's PSD increment consumption is typically determined through the use of an air quality dispersion model. Intrepid's facilities within the project area are classified as an existing source. Therefore, air dispersion modeling is required to demonstrate compliance with NAAQS and PSD increments as part of the air quality permit application to the NMED. The allowable PSD increments for Class I and Class II areas are presented in **Table 3.5-2**.

Air Quality Related Values

In addition to the more stringent PSD increments, Class I areas are protected by the FLMs who manage AQRVs. AQRVs include the potential air pollutant effects on visibility, atmospheric deposition, and the acidification of sensitive lakes and streams. They are applied to Class I areas, sensitive Class II areas, and set the level of acceptable change for each value. AQRVs reflect the land management agency's policy and are not legally enforceable standards.

Visibility

Visibility can be defined as the distance one can see (a standard visual range) or by the ability to perceive changes in color, contrast, and detail. The most commonly used reference for measuring visibility is the deciview, which is defined as a change in visibility that is perceptible to the average person.

Table 3.5-2 Class I and Class II Area PSD Increments

PSD Class	Pollutant	Allowable Increment (µg/m^3)		
		Annual Arithmetic Mean	24-hour Maximum	3-hour Maximum
Class I	NO_2	2.5	-	-
	SO_2	2	5	25
	PM_{10}	4	8	-
Class II	NO_2	25	-	-
	SO_2	20	91	512
	PM_{10}	17	30	-

[1] Modeled NO_X values were adjusted with an ARM of 0.75 to determine the NO_2 impacts. Values in parentheses represent the modeled NO_X values.

[2] The modeled value of 5.02346 is for the annual averaging period and the modeled value of 17.55345 is for the 24-hour averaging period.

N/A – Not available as Class I increment modeling and Class II SO_2 increment modeling was not required.

Source: Intrepid Potash 2010b.

Regional haze is visibility impairment that is caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Scattering and absorption of light by fine pollutant particles results in the development of regional haze and consequent visibility reduction. Some particles and gases scatter light while others absorb light. The primary cause of regional haze in many parts of the country is light scattering from fine particles (i.e., $PM_{2.5}$) in the atmosphere. Coarse particles between $PM_{2.5}$ and PM_{10} can contribute to light extinction. Each of these components of regional haze can be naturally occurring or the result of human activity. The natural levels of these components may result in some visibility impairment, even in the absence of human influences, and will vary with season, weather, and geography (USEPA 2003).

The primary contributors to the reduction of visibility at Guadalupe Mountain NP, in order of decreasing contribution, are sulfates, soil or crustal material, and organic compounds. The monthly average contribution of sulfates to visibility reduction varies between 30 percent to 60 percent. The monthly average contribution of soil to visibility reduction varies between 10 percent to 40 percent. The highest reduction in visibility tends to occur in the month of September, with the clearest days occurring in winter months (IMPROVE undated). This is also representative of the effects on visibility at Carlsbad Caverns NP.

Atmospheric Deposition and Acid Neutralization Capacity

Atmospheric deposition, wet and dry, is the process whereby airborne particles and gases are removed from the atmosphere and deposited on the earth's surface.

Wet deposition is defined as the portion of atmospheric deposition contained in precipitation. Wet deposition is monitored by the National Atmospheric Deposition Program, a consortium of a large number of federal, regional, state agencies, and academic institutions.

Dry deposition is the fraction of atmosphere deposited in dry weather through processes such as settling, impaction, and adsorption. The factors that influence dry deposition include whether the substance is in gaseous or particulate form, the solubility of the species in water, the amount of precipitation in the region, terrain, and type of surface cover.

Mixing of specific compounds in the atmosphere can lead to acid deposition. Acidic wet deposition is called acid precipitation or, more commonly, acid rain. Acidity in precipitation is measured by collecting samples of rain and measuring its pH, which is lower when acidic compounds are present. “Clean” or unpolluted rain has a slightly acidic pH of 5.6, because carbon dioxide (CO_2) and water in the air react together to form carbonic acid, a weak acid.

The National Atmospheric Deposition Program (NADP) monitors the atmospheric deposition of air containments to the ground surface via both wet deposition and dry deposition processes. The NADP has a monitoring site at Guadalupe Mountain NP. In general, the precipitation at the Guadalupe site has generally experienced an increase in pH levels (equivalent to decreasing acidity) since monitoring was initiated in 1984. Changes to the inputs of nutrients, such as ammonium, can have effects to ecosystems, particularly in areas that have adapted to low levels of nutrients, such as desert environments (NADP 2011).

3.5.1.4 Nonattainment New Source Review and Conformity for General Federal Actions

While new emissions sources in attainment areas are required to follow PSD regulations, Nonattainment New Source Review is required for major stationary sources locating or expanding in nonattainment areas. According to Section 176 of the CAA (40 CFR 51.853), a federal agency must make a conformity determination in the approval of a project with air emissions that exceed specified thresholds in nonattainment and/or maintenance areas. This General Conformity Rule ensures that the actions taken by federal agencies in non-attainment and maintenance areas meet national standards for air quality and/or do not cause further degradation to air quality that would be inconsistent with the attainment and maintenance of ambient air quality standards. The proposed project is not located within a non-attainment or maintenance area identified by NMED-AQB or USEPA; therefore, a general conformity analysis would not be required for evaluating impacts to air quality before implementing the proposed project.

3.5.1.5 New Source Performance Standards

Under Section 111 of the CAA, USEPA is authorized to establish NSPS, which impose federal technology-based requirements on new, modified and reconstructed stationary sources of pollution. USEPA has developed NSPS for numerous source categories, which are published at 40 CFR Part 60. Although USEPA has responsibility for implementing and enforcing the NSPS regulations, Section 111(c) authorizes USEPA to delegate primary implementation and enforcement responsibility to state and local agencies that develop and submit acceptable procedures for implementing and enforcing the NSPS.

NSPS standards define emission limitations that would be applicable to a particular source group. The NSPS potentially applicable to the project include the following subparts of 40 CFR Part 60:

- Subpart A—General Provisions
- Subpart OOO—Standards of Performance for Nonmetallic Mineral Processing Plants.

Subpart A— General Provisions

Certain provisions of Subpart A apply to the owner or operator of any stationary source subject to a NSPS. Provisions of Subpart A potentially would apply depending on the applicability of emission generating units to be installed as part of the proposed new facilities.

Subpart OOO—Nonmetallic Mineral Processing Plants

Subpart OOO applies to certain activities located at portable or fixed nonmetallic mineral processing plants, including crushers, grinding mills, screening operations, bucket elevators, belt conveyors, storage bins, and enclosed truck loading stations. If a nonmetallic mineral is processed by an affected facility as part of the proposed project, the requirements of Subpart OOO would apply to material handling activities if the equipment is manufactured after the applicability date in the rule. The requirements of Subpart OOO include an emission limit of 0.014 grains per dry standard cubic foot and 7 percent opacity on stack emissions with capture systems, 7 percent opacity from fugitive emissions from affected facilities, and 12 percent opacity from fugitive emissions from crushers. Compliance is determined using USEPA Reference Method 5 or Method 17 for stack emissions and Reference Method 9 for opacity determinations. Recordkeeping and reporting must follow the requirements contained in CAA §60.676.

3.5.1.6 Maximum Achievable Control Technology Standards

The CAA requires USEPA to regulate toxic air pollutants from large industrial facilities and to develop standards for controlling the emissions of air toxics from sources in an industry group (or source categories). Under the National Emission Standards for Hazardous Air Pollutants (HAPs), the USEPA promulgated standards pursuant to Section 112 of the 1990 CAA Amendments. The rules are provided in 40 CFR 63. The standards for these sources are known as Maximum Achievable Control Technology (MACT) standards, and are based on emissions levels that are already being achieved by the better-controlled and lower-emitting sources in an industry.

USEPA is required to identify categories of industrial sources that emit one or more of the listed 187 toxic air pollutants. These industrial categories include both major and area sources, including those listed below:

- Major sources of air toxics that emit 10 tons per year (tpy) of a single air toxic or 25 tpy of a combination of air toxics.
- Area sources release smaller amounts of toxic pollutants into the air—less than 10 tpy of a single air toxic, or less than 25 tpy of a combination of air toxics. Although emissions from individual area sources are often relatively small, cumulatively their emissions can be of concern (USEPA 2009).
- In the Integrated Urban Air Toxics Strategy, the USEPA identifies the toxic air pollutants that pose a health threat in the largest number of urban areas and regulates sufficient area source categories to ensure that the emissions of these "urban" air toxics are reduced.

The proposed project will be a minor source of HAPs, and there are currently no applicable area source MACT standards that apply to the proposed project.

3.5.1.7 Federal Operating Permits Program

All major stationary sources (primarily industrial facilities and large commercial operations) emitting certain air pollutants are required to obtain Title V operating permits under the Federal Operating Permits Program outlined in 40 CFR Part 70 of the CAA. Whether a source meets the definition of "major" depends on the type and amount of air pollutants it emits and, to some degree, on the overall air quality in its vicinity. Generally, major sources include stationary facilities that emit 100 tons or more per year of a regulated air pollutant including compounds such as CO, PM_{10}, $PM_{2.5}$, volatile organics, SO_2, and NO_X. Major sources of toxic air pollutants (i.e., any source that emits more than 10 tpy of an individual toxic air pollutant or more than 25 tpy of any combination of toxic air pollutants) are also covered under the Federal Operating Permits Program.

The proposed project will be a minor source with respect to the Federal Operating Permits Program; therefore, a Title V operating permit will not be required.

3.5.1.8 Hazardous Air Pollutants

HAPs are those pollutants known or suspected to cause cancer or other serious health effects, such as damage to reproduction, birth defects, or adverse environmental impacts. The USEPA has classified

187 air pollutants as HAPs, including formaldehyde, benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds, and normal hexane (n-hexane).

The largest sources of HAPs in Eddy County come from oil and gas operations. These existing sources of HAPs include emission sources such as compressor engines (benzene, ethylbenzene, formaldehyde, toluene, xylenes, and hexane) and glycol dehydrators (benzene, toluene, ethylbenzene, H_2S, and xylenes). Neither the State of New Mexico nor the USEPA have established ambient air quality standards for HAPs; however, the 1990 CAA amendments established a program to regulate emissions of 189 HAPs from particular industrial sources. The Act required the USEPA to regulate emissions of these HAPs by developing and promulgating technology-based standards based on the best-performing similar facilities in operation. The NESHAP established by USEPA are part of the MACT standards. MACT standards are designed to reduce HAP emissions to a maximum achievable degree, taking into consideration the cost of reductions and other factors.

The criteria used by the USEPA to assess HAP impacts are reference concentrations (RfC) for chronic inhalation exposure and Reference Exposure Levels (RELs) for acute inhalation exposures. The RfC represents the maximum concentration at which no appreciable risk of harmful health effects would occur with the human population, including sensitive groups. The REL is the maximum acute concentration (1-hour average) for which no adverse health effects would occur within the human population. The levels of HAPs that require modeling in New Mexico are the Title V major source thresholds of 10 tpy for any HAPs and 25 tpy for total HAPs, regulated by NMED-AQB under 20.2.70 NMAC.

The NMED-AQB developed criteria for use in evaluating potential health and environmental impacts and obtaining more detailed information during the air permitting process. The NMED-AQB adopted Occupational Exposure Level (OEL) based upon threshold values developed by the American Conference of Governmental Industrial Hygienists (ACGIH) as guidelines for potential toxic emissions of permitted facilities. The reference concentrations and levels of toxicity for screening HAPs that are commonly used for HAP analyses are listed in **Table 3.5-3**. If air quality analyses show that the maximum 8-hour average concentration of all toxics is less than 1 percent of the OEL for that HAP, then the analysis of that toxic pollutant is determined to be complete for New Mexico (NMED-AQB 2010b).

Table 3.5-3 Selected Hazardous Air Pollutants Reference and Screening Levels

Hazardous Air Pollutant	Reference Exposure Level (1-hour average) (µg/m^3)	Reference Concentration (annual average) (µg/m^3)	Toxic Screening Level (acute exposure) (µg/m^3)
Benzene[1]	1,300	30	53
Toluene[1]	37,000	400	6,280
Ethylbenzene[1]	350,000	1,000	14,473
Xylenes[1]	22,000	100	14,473
n-Hexane[1]	390,000	200	5,875
Formaldehyde[2]	94	9.8	37

[1] Toxic screening level (TSL) level from 24-hour averaging time.

[2] TSL level from 1-hour averaging time.

Source: USEPA 2009.

3.5.2 Regional Air Quality

Most of the current emission sources in the region are oil and gas facilities and mining locations. There are fugitive dust sources associated with these facilities, construction activities, and from roadways.

Existing disturbance within the project area is approximately 4,822 acres or 12.5 % (BLM 2010b). Principal facility sources of criteria pollutants in Eddy County, and the estimated amounts emitted in 2002 (the last year reported by USEPA) are indicated in **Table 3.5-4**. Updated combined air emissions information for Chaves, Eddy, and Lea counties can be found in the Southeast New Mexico Inventory of Air Pollutant Emissions and Cumulative Air Impact Analysis 2007 (BLM 2011).

Table 3.5-4 Eddy County 2002 Principal Source Facility Criteria Pollutant Emissions

Pollutant Emissions (tpy)							
CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Facility	Industry SIC
67.7	25.1	223.0	223.0	NA	NA	Potash Mine & Mill	1474 - Potash Soda & Borate Minerals
301.0	919.0	1.9	1.9	838.0	52.6	Artesia Gas Plant	1321 - Natural Gas Liquids
91.3	604.0	2.38	2.38	0.18	7.2	Pecos River Compressor Station	4922 - Natural Gas Transmission
394.0	387.0	187.0	112.0	1,975.0	1,024.0	Navajo Refining Co. - Artesia	2911 - Petroleum Refining
298.0	381.0	1.63	1.63	0.9	31.0	Atoka #3 Compressor Station	4922 - Natural Gas Transmission
396.0	361.0	2.36	2.19	2,040.0	60.4	Indian Basin Gas Plant	1311 - Crude Petroleum & Natural Gas

VOC = volatile organic compound

NA = not available.

Source: USEPA 2002a.

Analysis of air quality impacts from the HB In-Situ Solution Mine Project requires a representative baseline value for ambient background levels of pollutants. Ambient background levels are estimated by the NMED-AQB, as shown in **Table 3.5-5**.

Table 3.5-5 Ambient Background Levels of Criteria Pollutants in Eddy County

Pollutant	($\mu g/m^3$)
NO_2	NA
SO_2	NA
PM_{10}	20.0
$PM_{2.5}$	7.3
TSP	26.6
CO	NA

NA = not available.

Source: NMED-AQB 2010b.

3.5.2.1 Ozone

Ozone (O_3) is a photochemical oxidant and one of the components of smog. While O_3 in the upper atmosphere is beneficial because it shields the earth from harmful ultraviolet solar radiation, high concentrations at ground level can cause health problems due to lung irritation. O_3 is generated by a complex series of chemical reactions between volatile organic compounds (VOCs) and NO_X in the presence of ultraviolet radiation. High O_3 levels can result from VOCs and NO_X emissions from such sources as vehicles and industrial operations, affected by daytime wind flow patterns, mountain barriers, a persistent temperature inversion, and intense sunlight. Ozone precursors are products of combustion. Current background O_3 levels in the vicinity of the project area are shown in **Table 3.5-6**.

Table 3.5-6 2008 Air Quality Monitor Data Summary for Ozone

Location / Site ID	1st Maximum 8-hour Concentration for O_3 (ppm[1])	4th Maximum 8-hour Concentration for O_3 (ppm)	Number of Days Exceeding Federal Standard
Carlsbad, Eddy County, NM / 350151005	0.071	0.067	0
Carlsbad Caverns National Park, Eddy County, NM / 350153001	0.075	0.071	0[2]
Hobbs, Lea County, NM / 350250008	0.069	0.067	0

[1] ppm = parts per million.

[2] The federal standard for 8-hour concentration of O_3 is 0.075 ppm. The 8-hour standard is attained when the fourth highest 8-hour concentration each year, averaged over 3 consecutive years, is equal to or less than 0.075 ppm.

Source: USEPA20008a.

3.5.2.2 Hazardous Air Pollutants in Eddy County

Principal facility sources of HAPs in Eddy County that are most relevant to analysis of the proposed project and the estimated amounts emitted in 2002 (the last year reported by USEPA) are shown in **Table 3.5-7**. The existing potash mines and mills in Eddy County are small sources of HAPs.

Table 3.5-7 Eddy County 2002 Principal Source Facilities HAP and Potash Mine HAP Emissions

Facility	Pollutant Emissions (Pounds/Year)					
	Benzene	Ethylbenzene	Formaldehyde	Hexane	Toluene	Xylenes (Mixed Isomers)
Washington Ranch Compressor Station	8,800	800	4,400	12,620	10,800	0
Navajo Refining Co. – Artesia	7,252	9,900	3,400	10,960	35,840	23,480
Magnum Compressor Station	4,620	0	0	0	5,140	0
Peñasco Compressor Station	4,100	0	5,760	7,280	6,120	3,040
Empire Abo Plant	2,440	1,008,500	840	471,560	4,640	473,900
Mosaic Potash Mine and Mill	0.0001	0	0.0049	0	0	0
Total	**27,212**	**1,019,200**	**14,400**	**502,420**	**62,540**	**500,420**
Eddy County Total	*35,079*	*1,019,945*	*83,760*	*506,629*	*86,403*	*502,737*

Source: USEPA 2002b.

3.6 Climate Change

3.6.1 Regional Climate

New Mexico has a mild, arid or semiarid, continental climate characterized by light precipitation totals, abundant sunshine, low relative humidity, and a relatively large annual and diurnal temperature range. A climate summary for Carlsbad, New Mexico, is presented in **Table 3.6-1** (WRCC 2010). In January, the coldest month, average daytime high temperatures are in the mid to upper 50s (°F), and while minimum temperatures below freezing are common, it is rare that temperatures fall below 0°F. The coldest temperature on record at Carlsbad was -18°F on January 11, 1962. June and July are the warmest months with average daytime highs averaging in the upper 90s and occasionally exceeding 100°F. The hottest temperature recorded at the Carlsbad station was 113°F, and occurred in June 1994 and in July 1995.

State-wide average annual precipitation ranges from less than 10 inches over much of the southern desert to more than 20 inches at higher elevations in the state. A wide variation in annual totals is characteristic of arid and semiarid climates and is illustrated by annual extremes of 2.95 and 33.94 inches at Carlsbad during a period of more than 71 years. In the Pecos River Valley, summer rains fall almost entirely during brief, but frequently intense thunderstorms. July and August are the rainiest months in the proposed project area. Precipitation during the warmest 6 months of the year, May through October, adds up to about 80 percent of the annual total in the Carlsbad area. The southeastern plains of New Mexico receive on average only about 0.5 inch of precipitation each month during the period November through April.

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, stability, and wind (speed and direction). Mixing height is the height above ground at which rising warm air from the surface will mix with cooler ambient air by convection and turbulence. Local atmospheric conditions, terrain configuration, and source location determine the amount of dilution of pollutants in this mixed layer. Mixing heights vary diurnally, with the passage of weather systems, and with season. Wind speeds often are higher in the eastern plains diminishing the likelihood of long periods of stagnant air that can lead to air pollution episodes. On average, mean morning mixing heights in the project region are approximately 1,600 feet; mean afternoon mixing heights are more than 7,800 feet (Holzworth 1972). Mean morning mixing heights tend to be lowest in winter and highest in summer.

Morning atmospheric conditions tend to be stable due to the cooling of the layers of air nearest the ground. Afternoon conditions, especially during the warmer months, tend to be neutral to unstable because of the rapid heating of the surface under clear skies. During the winter, periods of stable afternoon conditions may persist for several days in the absence of synoptic (continental-scale) storm systems to generate higher winds with more turbulence and mixing. The latitude of the proposed project is within the belt of prevailing westerly winds that circle the globe around the earth's northern hemisphere. Winds are affected by local topographic features.

3.6.2 Climate Change

Greenhouse gases (GHG) consist of compounds in the earth's atmosphere that absorb outgoing long-wave radiation emitted from the earth's surface, resulting in a warming of the atmosphere. Naturally occurring greenhouse gases include water vapor, CO_2, methane (CH_4), nitrous oxide (N_2O), and O_3. Human activities also result in the release of GHG including several compounds containing fluorine, chlorine, or bromine that result, for the most part, from industrial activities. Through a natural carbon cycle, CO_2 is absorbed by the oceans and by living biomass through plant photosynthesis, and then released to the atmosphere through natural processes. As a result primarily of the combustion of fossil fuels the atmospheric concentration of CO_2 has increased about 36 percent since the beginning of the industrial age (USEPA 2008b).

In the U.S., the primary source of anthropogenic GHG emissions is fossil fuel combustion. Fossil fuel combustion accounted for 80 percent of 2008 GHG emissions (USEPA 2010a). Fossil fuels are responsible for supplying approximately 85 percent of U.S. primary energy needs and approximately 98 percent of estimated anthropogenic CO_2 emissions. N_2O is also a product of fossil fuel combustion but is largely accounted for as a byproduct of agricultural practices; methane is emitted by petroleum production operations (USEPA 2008a). The U.S. released approximately 5921.2 million metric tons of

Table 3.6-1 Monthly Climate Summary, Carlsbad Federal Aviation Administration Airport, New Mexico

Period of Record : 9/1/1942 to 12/31/2009													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (°F)	57.8	62.9	70.4	79.4	88.0	95.6	95.6	93.7	87.1	78.0	65.9	58.4	77.7
Average Minimum Temperature (°F)	29.4	33.3	39.2	47.7	57.1	65.2	68.7	67.3	60.5	48.9	36.9	29.9	48.7
Average Total Precipitation (inches)	0.34	0.40	0.41	0.47	1.18	1.23	1.75	1.95	2.28	1.10	0.52	0.48	12.12
Average Total Snow Fall (inches)	1.4	1.6	0.6	0.3	0	0	0	0	0	0	0.7	1.8	6.4
Average Snow Depth (inches)	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: (WRCC 2010)

CO_2 into the atmosphere in 2008. Of this total, approximately 30.0 million metric tons were released from natural gas systems (USEPA 2010b).

CH_4 is estimated to be more than 20 times as effective for trapping heat in the atmosphere as CO_2 (USEPA 2008a). The U.S. released approximately 567.6 million metric tons of CO_2 equivalents of CH_4 into the atmosphere in 2008. Of this total, approximately 96.4 million metric tons were released from natural gas systems (USEPA 2010b).

The Intergovernmental Panel on Climate Change (IPCC) recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in globally average temperatures since the mid-20th Century is very likely due to the observed increase in anthropogenic greenhouse gas concentration" (IPCC 2007).

Climate change is not shown to have a direct effect on any criteria pollutants other than ozone. It has been found that concentrations of ground level ozone are likely to increase due to increasing temperature. Although no other criteria pollutants have been shown to be directly impacted by climate change, potential future regulations aimed to reduce GHG emissions may have an indirect effect on other pollutants (such as NO_2 or SO_2) co-emitted with GHGs.

Potential impacts to air quality and other resources due to climate change are likely to be varied. For example, if global climate change results in a warmer and drier climate, increased particulate matter impacts could occur due to increased wind-blown dust from drier and less stable soils. Spatial ranges of cool season plant species are predicted to move north and to higher elevations, and extinction of endemic threatened/endangered plants may be accelerated. Due to loss of habitat, or due to competition from other species whose ranges may shift northward, the population of some animal species may be reduced. Less snow at lower elevations would be likely to impact the timing and quantity of snowmelt, which, in turn, could impact aquatic species.

The assessment of climate-changing pollutant emissions and climate change is in its formative phase; therefore, it is not yet possible to know with confidence the net impact to climate. The lack of scientific tools designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts, so there is no established mechanism to accurately predict the effect of local decisions on global climate change.

3.7 Vegetation

The study area for vegetation resources including general vegetation, noxious weeds and invasive species, and special status plant species is defined as the proposed project area. The following section presents general vegetation resources, noxious weeds and invasive species, and special status plant species for the project area.

3.7.1 Plant Communities

The project area is located within the Chihuahuan Desert ecoregion, which is composed of two subregions: the Chihuahuan Basins and Playas and Chihuahuan Desert Grasslands. The Chihuahuan Desert ecoregion extends from the southeastern Arizona to south-central Texas, and more than 500 miles south into Mexico (Griffith et al. 2006). The Chihuahuan Desert ecoregion historically has been dominated by desert grasslands, and shrublands dominated by creosotebush (*Larrea tridentata*). Over the last several hundred years, the extent of desert grasslands has declined, and desert shrublands have become increasingly dominant. The gradual desertification is thought to be caused by grazing, and other anthropogenic activities (Griffith et al. 2006; New Mexico State University 2007). The Chihuahuan Basins and Playas subregion is located mostly below 4,500 feet amsl. It is composed of saline and alkaline soils, salt flats, dunes, and windblown sand (Griffith 2006). The Chihuahuan Desert Grasslands are found at higher elevations, such as elevated basins between mountain ranges, low mountain benches, plateau tops, and north-facing mountain slopes (Griffith 2006). Both the Chihuahuan subregions are extremely arid; however, the Chihuahuan Desert Grasslands have higher annual precipitation than the Chihuahuan Basins and Playas.

In the project area, the climate is arid, with annual rainfall ranging from 10 to 15 inches a year (NRCS 2008a). Elevation varies typically from 3,000 to 4,500 feet (NRCS 2008a). Vegetation types and acreages were analyzed using the Southwest Regional Gap Analysis Project (SWReGAP) Land Cover data (USGS 2004). The SWReGAP land cover type categories were grouped into eight general vegetation cover types: desert scrub, dune and sand flat scrub, grassland, mesquite upland scrub, riparian, woody riparian, sandhill shrubland and open water. **Table 3.7-1** summarizes acreages for each vegetation cover type within the project area. The acreage of each vegetation cover type within the two existing pipelines (Caprock East Pipeline and HB/Eddy Caprock Pipeline) and the new proposed Caprock pipeline are listed in **Table 3.7-2**. Descriptions of the plant communities for each vegetation cover type are provided in the following text. Community characterizations were compiled based on SWReGAP Land Cover descriptions (USGS 2005), and soil survey habitat descriptions (NRCS 2008a). Species nomenclature is consistent with the NRCS Plants Database (NRCS 2008b), the New Mexico Rare Plant List (NMRPTC 1999, NMAC 19.21.2.1 to 19.21.2.15), the BLM Carlsbad Field Office, and the New Mexico State Noxious Weed List (NMSA 76-7-1 to 76-7-30). **Figure 3.7-1** illustrates the vegetation cover types present within the project area.

Table 3.7-1 Vegetation Cover Types within the Project Area

Vegetation Cover Type	Acres	% of Project Area
Desert scrub	12,302	32
Dune and Sand Flat Scrub	7	< 1
Grassland	5,733	15
Mesquite Upland Scrub	17,264	45
Riparian	429	1
Woody Riparian	751	2
Sandhill Shrubland	834	2
Water	1,132	3
Total	**38,453**	**100**

Table 3.7-2 Vegetation Cover Types within the Caprock Pipeline Routes

Vegetation Cover Type	Pipeline Routes	
	Existing East Caprock and HB/Eddy Pipelines	Proposed New Caprock Pipeline
	Acres	
Desert scrub	41	30
Dune and Sand Flat scrub	5	5
Grassland	103	89
Mesquite Upland Scrub	188	120
Riparian	0	0
Woody Riparian	0	2
Sandhill Shrubland	49	15
Water	0	1
Total	**386**	**262**

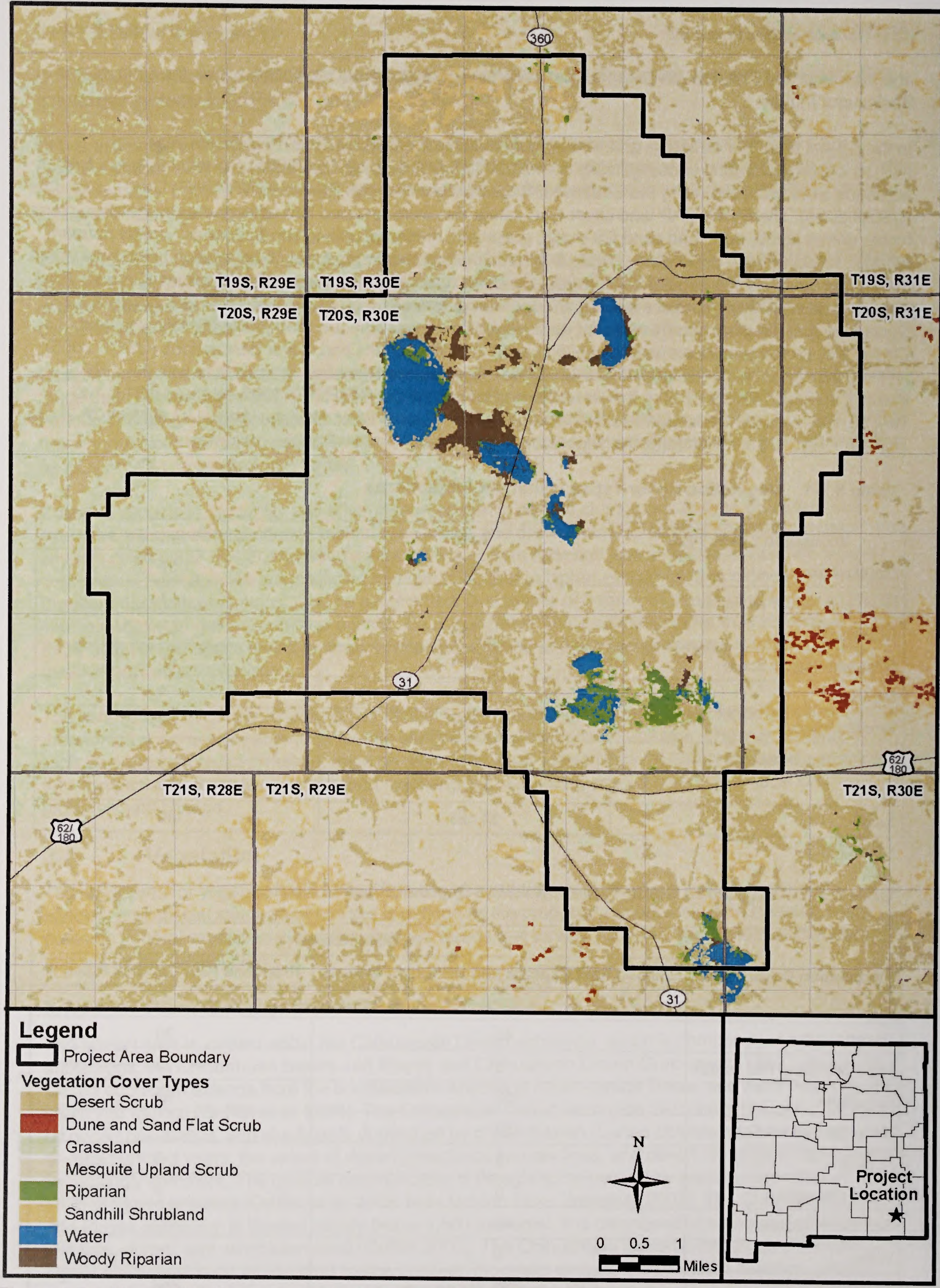


Figure 3.7-1. Vegetation Cover Types in the Project Area

Desert Scrub

Desert scrub is the second most common cover type in the project area and is found in combination with the Mesquite Upland Scrub vegetation cover type throughout the majority of the project area. It is composed of several land cover types: the Chihuahuan Creosotebush Xeric Basin Desert Scrub, the Chihuahuan Mixed Desert and Thorn Scrub, and Chihuahuan Mixed Salt Desert Scrub. The Chihuahuan Creosotebush Xeric Basin Desert Scrub landcover type occurs in xeric basins and plains, the Chihuahuan Mixed Desert and Thorn Scrub is found in the transition zone between the foothills and lower montane woodlands, and the Chihuahuan Mixed Salt Desert Scrub occurs in saline basins, alluvial flats and around playas. Vegetation consists of creosotebush often found with other desert scrub species such as American tarwort (tarbush) (*Flourensia cernua*), catclaw mimosa (*Mimosa aculeaticarpa* var. *biuncifera*), junipers (*Juniperus* spp.), honey mesquite (*Prosopis glandulosa*), and plumed crinklemat (*Tiquilia greggii*). In the Chihuahuan Mixed Salt Desert Scrub areas, the dominant shrub species tend to be salt tolerant such as fourwing saltbush (*Atriplex canescens*) and other atriplex species (*Atriplex* spp.) associated with the above shrub species. Herbaceous species have lower cover than shrubs in these areas and common species include side-oats grama (*Bouteloua curtipendula*), black grama (*Bouteloua eriopoda*), bush muhly (Muhlenbergia porter), Tobosagrass (*Pleuraphis mutica*), Plains bristlegrass (*Setaria* spp.), Plains lovegrass (*Eragrostis intermedia*), and alkali sacaton (*Sporobolus airoides*).

Dune and Sand Flat Scrub

The Dune and Sand Flat Scrub cover type occurs in a very limited extent in the project area. It is found on vegetated coppice dunes and sandsheets. It consists of open shrublands with 10 to 30 percent cover dominated by honey mesquite. Other typical shrub species includes fourwing saltbush, Torrey's jointfir (*Ephedra torreyana*), longleaf jointfir (*Ephedra trifurca*), littleleaf sumac (*Rhus microphylla*), and broom snakeweed (*Gutierrezia sarothrae*).

Grassland

The Grassland cover type is found on a broad range of geologic areas and soil types. It is the third most common vegetation cover type, and is found on the western side of the project area. It occurs on alluvial fans, flats, slopes and basins, sandy plains and sandstone mesas. It is found on moderate to deep soils; gypsum outcrops; sandy gypsiferous and/or alkaline soils; sandy to clayey loamy, ustic soils; and soils with high sand content. The vegetated cover is typically dominated by graminoids with an open shrub layer. Graminoid species include blue grama, needle-and-thread grass (*Hesperostipa comata*), alkali sacaton, gypsum grama (*Bouteloua breviseta*), purple threeawn (*Aristida purpurea*), side-oats grama, sand dropseed (*Sporobolus cryptandrus*), hairy grama (*Bouteloua hirsuta*), and black grama (*Bouteloua eriopoda*). Shrubs and dwarf shrubs include sand sagebrush (*Artemisia filifolia*), fourwing saltbush, honey mesquite, soaptree yucca, crinklemat species (*Tiquilia* spp.), broom snakeweed, Torrey's jointfir, Apache plume (*Fallugia paradoxa*), and Torrey's yucca (Yucca torreyi). The vegetative cover is influenced by the underlying soil type. Sandy soils have higher cover of spike dropseed, soaptree yucca, and needle-and-thread grasses; while gypsum soils are dominated by gypsophilous plants such as gypsum grama. Microphytic crust can be important in some areas, while disturbance such as grazing may be necessary to maintain the shrub component.

Mesquite Upland Scrub

The Mesquite Upland Scrub cover type is the most dominant vegetation cover type and is found in combination with Desert Scrub throughout the majority of the project area. It is composed of upland shrublands and is typically found in the transition zone of foothills and piedmonts of the Chihuahuan Desert Ecoregion. It is typically found on alluvium derived substrates that are often gravelly. Vegetation is typically dominated by shrubs with little grass cover. The deep-rooted shrubs are able to exploit the deep soil moisture that is unavailable to grasses and cacti. Species include honey mesquite, littleleaf sumac, soapberry (*Sapindus* spp.) and other succulent species. Desertification has increased the extent of Mesquite Upland Scrub.

Riparian

The Riparian cover type occurs around channels, temporary springs, playas, closed basin lakes and tailings ponds in the project area. The vegetation can vary from sparse and patchy to moderately dense. Typical species can include salt-tolerant and halophytic species such as saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and foxtail barley (*Hordeum jubatum*). Other typical species can include rushes (*Juncus* spp.), sedges (*Carex* spp.), bulrush (*Schoenoplectus* spp.), cattails (*Typha* spp.), desert broom (*Baccharis sarothroides*), and burrobrush species (*Hymenoclea* spp.).

Woody Riparian

The Woody Riparian cover type is located around the lakes located in the east and south portions of the project area. The vegetation is composed of a mix of riparian woodlands and shrublands. Dominant tree and shrub species can include cottonwoods (*Populus* spp.), willows (*Salix* spp.), and boxelder (*Acer negundo*). In the project area, much of the woody riparian vegetation is salt cedar.

Sandhill Shrubland

The Sandhill Shrubland cover type occurs on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing. Sandhill Shrubland is characterized by a sparse to moderately dense woody layer dominated by sand sagebrush and shinnery oak (*Quercus havardii*) and various grass species. Graminoid species include little bluestem (*Schizachyrium scoparium*), spike dropseed (*Sporobolus contractus*), sand bluestem (*Andropogon hallii*), switchgrass (*Panicum virgatum*), and giant dropseed (*Sporobolus giganteus*). Shinnery oak is a low shrub that has large underground stem and root systems. It can resprout following a fire and thus may persist for long periods of time once established. Fire and grazing are the most important dynamic processes for maintaining this type; however, drought stress can impact this system significantly in some areas.

Water

The Water cover type consists of the open surface water in the project area, including temporary springs, playas, basin lakes, and tailings ponds.

In response to the increase of desert shrublands, and the decline of desert grasslands, the BLM and its partners have implemented vegetation treatments to restore the desert grasslands. Over two-thirds of desert grasslands in southern New Mexico has been invaded by shrub species, primarily mesquite and creosote (BLM 2009). Vegetation treatments to restore desert grasslands include chemical treatments, grazing deferments, prescribed fires, and mechanical removal. In the project area, the targeted shrub species are creosote, mesquite, and salt cedar. Recent vegetation treatment included aerial spraying of 39,435 acres to control mesquite in Clayton Basin. **Figure 3.7-2** displays the location of the recent vegetation treatment applied in the project area.

3.7.2 Special Status Plant Species

Special status plant species are species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species protected under the ESA, species that are candidates for listing by the USFWS, species that are listed by the state as threatened or endangered, and BLM sensitive species.

In accordance with the ESA, the lead agency, in coordination with the USFWS, must ensure that any federal action to be authorized, funded, or implemented would not adversely affect a federally listed threatened or endangered species or its critical habitat. The BLM Special Status Species Management Policy 6840 requires the BLM to manage and protect any USFWS candidate species, or state listed

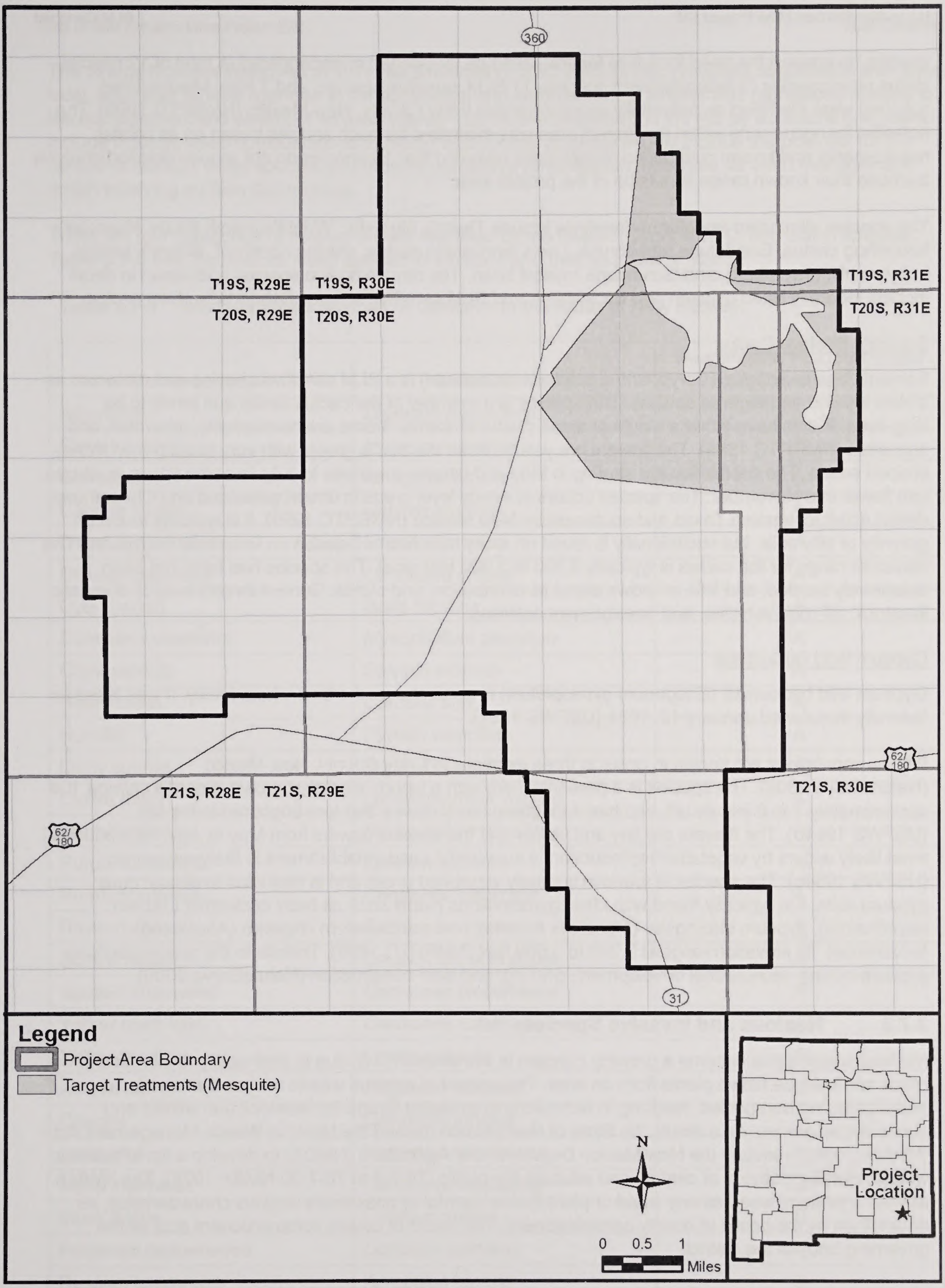


Figure 3.7-2. Recent Vegetation Treatments in the Project Area

species, to prevent the need for future federal listing as threatened or endangered. A total of 12 special status plant species (3 federally listed species, 11 BLM sensitive species, and 7 New Mexico listed species) were identified as potentially occurring within Eddy County, New Mexico (NMRPTC 1999). The potential for occurrence within the project area was evaluated for each species based on its habitat requirements and known distribution. Evaluations revealed that 10 species do not require detailed analysis because their known range is outside of the project area.

The species eliminated from further analysis include Tharp's blue-star, Wright's marsh thistle, Kuenzler's hedgehog cactus, Guadalupe rabbitbrush, Lee's pincushion cactus, shining coralroot, Wright's justicia, hairy muhly, gray sibara, and Guadalupe mescal bean. The remaining two species addressed in detail include federally listed gypsum wild buckwheat, and BLM sensitive species Scheer's beehive cactus.

Scheer's Beehive Cactus

Scheer's beehive cactus (*Coryphantha scheeri* spp. *scheeri*) is a BLM sensitive species and protected as a New Mexico endangered species. The species is a member of the cactus family and tends to be long-lived. Plants have either a single or small cluster of stems. Stems are hemispheric, tubercled, and succulent (NMRPTC 1999). The flowers are yellow, while the fruit is green, with very small brown kidney shaped seeds. The cactus flowers starting in May and usually continues to July. In some cases, cactuses can flower into November. The species occurs in nearly level areas in desert grassland and Chihuahuan desert scrub in western Texas and southeastern New Mexico (NMRPTC 1999). It is typically found on gravelly or silty soils, but occasionally is found on rocky benches or bajadas on limestone or gypsum. The elevation range for the cactus is typically 3,300 to 3,600 feet amsl. The species has been not been extensively studied, and little is known about its distribution, and status. Current threats include domestic livestock, off-road vehicles, and development activities.

Gypsum Wild Buckwheat

Gypsum wild buckwheat (*Eriogonum gypsophilum*) is a member of the buckwheat family. It was listed as federally threatened January 19, 1981 (USFWS 1981).

Fifteen populations are known to occur in three locations in Eddy County, New Mexico (NatureServe 2009). The species is a perennial herb with a woody stem that grows in dense clumps. It is approximately 7 to 8 inches tall, and has dark green basal leaves that turn bright red in the fall (USFWS 1984b). The flowers are tiny and yellow and the species flowers from May to July. Reproduction most likely occurs by vegetative reproduction, a successful seed establishment is likely uncommon (USFWS 1984b). The species is found in sparsely vegetated areas and is restricted to almost pure gypsum soils. It is typically found with other gypsophilous plants such as hairy crinklemat (*Tiquilia hispidissima*), gypsum blazingstar (*Mentzelia humilis*), and southwestern ringstem (*Anulocaulis leiosolenus*). Its elevation range is 3,280 to 3,600 feet (NMRPTC 1999). Threats to the species include gypsum mining, recreational development, grazing, and dam construction (NatureServe 2009).

3.7.3 Noxious and Invasive Species

Noxious weeds have become a growing concern in the western U.S. due to their ability to increase in cover and exclude native plants from an area. The spread of noxious weeds causes damage to endangered native species, resulting in reductions in available forage for livestock and wildlife and economic resources. As a result, the State of New Mexico passed the Noxious Weeds Management Act (NWMA), which requires the New Mexico Department of Agriculture (NMDA) to develop a list of noxious weeds, identify methods of control, and educate the public (76-7-1 to 76-7-30 NMSA 1978). The NWMA defines a noxious weed as any weed or plant that is harmful or possesses noxious characteristics, as determined by the board of county commissioners. The board of county commissioners acts as the governing body of the district.

The federal Noxious Weed Act of 1974, as amended (7 USC 2801 et seq.) requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds. The BLM acknowledged the Act by establishing a goal to include noxious weed considerations in NEPA documents. Analysis should include the potential for the spread of noxious weed species and provide preventive rehabilitation measures for each management action involving surface disturbance.

There are four categories of noxious weeds identified by the NMDA (Class A, B, C, and watch species). **Table 3.7-3** lists the noxious weed species in the state and their associated status.

Table 3.7-3 Noxious Weed Species of Concern in the State of New Mexico.

Common Name	Scientific Name	New Mexico Noxious Weed List Classification
Alfombrilla	*Drymaria arenariodes*	A
Black henbane	*Hyoscyamus niger*	A
Camelthorn	*Alhagi psuedalhagi*	A
Canada thistle	*Cirsium arvense*	A
Dalmation toadflax	*Linaria dalmatica*	A
Diffuse knapweed	*Centaurea diffusa*	A
Dyer's woad	*Isatis tinctoria*	A
Eurasian watermilfoil	*Myriophyllum spicatum*	A
Giant salvinia	*Salvinia molesta*	A
Hoary cress	*Cardaria* spp.	A
Hydrilla	*Hydrilla verticllata*	A
Leafy spurge	*Euphorbia esula*	A
Oxeye daisy	*Leucanthemum vulgare*	A
Parrotfeather	*Myriophyllum aquaticum*	A
Purple loosestrife	*Lythrum salicaria*	A
Purple starthistle	*Centaurea calcitrapa*	A
Ravenna grass	*Saccharum ravennae*	A
Scotch thistle	*Onopordum acanthium*	A
Spotted knapweed	*Centaurea biebersteinii*	A
Yellow starthistle	*Centaurea solstitialis*	A
Yellow toadflax	*Linaria vulgaris*	A
African rue	*Peganum harmala*	B
Chicory	*Cichorium intybus*	B
Halogeton	*Halogeton glomeratus*	B
Malta starthistle	*Centaurea melitensis*	B
Musk thistle	*Carduus nutans*	B
Perennial pepperweed	*Lepidium latifolium*	B
Russian knapweed	*Acroptilon repens*	B
Poison hemlock	*Conium maculatum*	B

Table 3.7-3 Noxious Weed Species of Concern in the State of New Mexico.

Common Name	Scientific Name	New Mexico Noxious Weed List Classification
Teasel	*Dipsacus fullonum*	B
Tree of heaven	*Ailanthus altissima*	B
Bull thistle	*Cirsium vulgare*	C
Cheatgrass	*Bromus tectorum*	C
Jointed goatgrass	*Aegilops cylindrica*	C
Russian olive	*Elaeagnus angustifolia*	C
Saltcedar	*Tamarix* spp.	C
Siberian elm	*Ulmus pumila*	C
Crimson fountaingrass	*Pennisetum setaceum*	Watch
Giant cane	*Arundo donax*	Watch
Meadow knapweed	*Centaurea pratensis*	Watch
Pampas grass	*Cortaderia sellonana*	Watch
Quackgrass	*Elytrigia repens*	Watch
Sahara mustard	*Brassica tournefortii*	Watch
Spiny cocklebur	*Xanthium spinosum*	Watch
Wall rocket	*Diplotaxis tenuifolia*	Watch

Class A species are the highest priority but are not currently present in New Mexico or have limited distribution. Management of Class A species focuses on prevention of new infestations, and eradication of existing infestations.

Class B species are limited to portions of the state. For Class B species, with severe infestations, management includes containing the infestation and limiting any further spread.

Class C species are widespread in the state. For Class C species, management decisions are made at the local level based on the feasibility of control and level of infestation. Watch species are species of concern in the state that have the potential to become problematic. When these species are encountered, their location should be documented and provided to the appropriate authorities.

In the state, African rue, Malta star-thistle, and Russian knapweed are of the highest concern. In the project area, African rue and goldenrod have been identified and treated. Malta star-thistle is usually found along roadways in the project area. Along the proposed Caprock pipeline route, African rue and Malta star-thistle have been observed. Russian knapweed has not been identified in the project area, but could be present. In addition, salt cedar (tamarisk) is not prevalent in the project area, but is still a concern due to the presence of large infestations nearby. Lehmann's lovegrass (*Eragrostis lehmanniana)* is an invasive species of concern to the BLM as it is very invasive on disturbed areas. It has been observed in the project area (Daly 2010).

The BLM Carlsbad along with county, state, and federal agencies actively monitor and treat noxious weed species in the area.

3.8 Wildlife and Fish

3.8.1 Terrestrial Wildlife

Wildlife habitats within the project area consist primarily of mesquite upland shrub, desert scrub, and grasslands, with small areas of sandhill shrubland, dune and sand flat scrub, woody riparian, and open water habitats. These vegetation types support a diversity of wildlife species. This section focuses on species of high economic or recreational importance and those that are considered sensitive to human disturbance.

3.8.1.1 Big Game

Big game species potentially occurring within the project area may be limited due to lack of sufficient feed or cover. The primary big game species are mule deer (*Odocoileus hemionus*) and pronghorn antelope (*Antilocapra americana*) (BLM 1994). According to the Carlsbad Final RMP/EIS Amendment (BLM 1997), mule deer are found east of the Pecos River in isolated areas that have adequate permanent water sources, adequate cover (dunes, escarpments, blowouts, and hummocks), abundant food sources (shinnery oak and fourwing saltbush), and some topographic relief. These factors, and the proximity to oil and gas activity, are the limiting factors to the distribution of mule deer in the vicinity of the project area (BLM 1994). Habitat for pronghorn antelope primarily consists of grassy rolling uplands and shinnery oak sand dunes (BLM 1994).

Other big game species that may be encountered within the project area include javelinas (*Dicotyles tajacu*) and mountain lions (*Felis concolor*). Javelinas prefer areas of mixed desert shrub or mesquite grassland, and mountain lions may occasionally travel through the mesquite grasslands and shinnery oak dune areas in and near the project area (BLM 2007b).

3.8.1.2 Small Game Species

Small game species that potentially occur within the project area include upland game birds, waterfowl, furbearers, and small mammals. Species include mourning dove (*Zenaidura macroura*), scaled quail (*Callepepla squamata*), bobwhite quail (*Colinus virginianus*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus audubonii*). Furbearers may include, but are not limited to, bobcat (*Lynx rufus*), coyote (*Cannis letrans*), raccoon (*Procyon lotor*), and badger (*Taxidea taxus*) (BLM 2007b, 1994).

3.8.1.3 Nongame Species

A diversity of nongame species (e.g., small mammals, raptors, passerines, amphibians, and reptiles) occupy a variety of trophic levels (levels in the food chain) and habitat types within the project area. Nongame mammal species include shrews, bats, squirrels, rabbits, woodrats, and mice. These small mammals provide a substantial prey base for the predators, such as mammals (coyote, badger, skunk), raptors (eagles, buteos, accipiters, owls), and reptiles.

Nongame birds encompass a variety of passerine and raptor species, these include a diversity of neotropical migrants (birds that breed in North America and winter in the neotropical region of South America). These birds are considered integral to natural communities and act as environmental indicators due to their sensitivity to environmental changes. Common bird species that occur within the project area may include, but are not limited to, horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), Chihuahuan raven (*Corvus cryptoleucus*), western kingbird (*Tyrannus vertucalis*), and sage sparrow (*Amphispiza belli*) (BLM 2007b). Representative raptor species include the golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), rough-legged hawk (*Buteo lagopus*), ferruginous hawk (*Buteo regalis*), American kestrel (*Falco sparverius*), and great-horned owl (*Bubo virginianus*) (BLM 2007b).

Pursuant to Executive Order (EO) 13186 (2001), a Memorandum of Understanding between the BLM, USFS, and USFWS was drafted in order to promote conservation and protection of migratory birds. The EO provides guidance to federal agencies to minimize adverse effects and promote best management practices for the conservation of migratory birds.

Breeding bird surveys were conducted in May 2008 within the project area (CEHMM 2008). Avian species observed within and adjacent to the project area included Harris's hawk (*Parabateo unisinctus*), Swainson's hawk, northern harrier (*Circus cyaneus*), cactus wren (*Campylorhynchus brunneicapillus*), sage thrasher (*Oreoscoptes montanus*), mourning dove, American avocet (*Recurvirostra Americana*), and spotted sandpiper (*Actitis macularia*). Additionally, a number of the karst caves in the area are known to provide roosting, nesting, or other protective habitat for many animal species, including raptors, owls, bats, and other small animals (BLM 1981, 1978; Southwest Region National Speleogical Society 1991). Details on sensitive species such as lesser prairie chicken (*Tympanuchus pallidicinctus*), burrowing owl (*Athene cunicularia*), Baird's sparrow (*Ammodramus bairdii*), gray vireo (*Vireo vicinior*), cave myotis (*Myotis velifer incautus*), Yuma myotis (*Myotis yumanensis yumanensis*), sand dune lizard (*Sceloporus arenicolus*), and Pecos pupfish (*Cyprinodon pecosensis*) are discussed further in Section 3.8.3, Sensitive Species.

3.8.1.4 Habitat Fragmentation

Habitat fragmentation is known to affect wildlife regardless of the location, but the degree to which wildlife is affected and the species-specific impacts are inconclusive. As the number of fragments increases in a given area, the core area size decreases, reducing the patches uninterrupted by human disturbance. The amount of edge area increases with the increase of fragments, and habitat connectivity decreases with increased fragmentation (Baker and Knight 2000).

Concern for habitat fragmentation is increasing in wildlife management (Baker 2000; Baker and Knight 2000) and is considered a global concern for biological diversity (Baker and Knight 2000). The decrease of species and shifts of animal distributions have led to a focus on the causes of habitat fragmentation and the effect this may have on wildlife. Avian responses to habitat fragmentation include life cycle alterations, increased parasitism, and habitat affinity associations (Baker Knight 2000; Weller et al. 2002). Many of the documented concerns related to habitat fragmentation apply primarily to forested environments.

The effects analysis of habitat fragmentation focuses on fragmentation from roads, which are the predominant linear features on the district, based on a review of relevant studies for the western U.S. and the documented impacts to wildlife (chiefly big game). Habitat loss from roads or other linear structures has broader effects than just the conversion of a small area of land. Roads fragment wildlife habitat by changing landscape structure, which may have direct and indirect impacts, depending on the species present. Habitat effects of roads on the landscape include dissecting vegetation patches, increasing the edge-affected area, decreasing contiguous interior area, and increasing the uniformity of patch characteristics such as shape and size (Reed et al. 1966). Avoidance distances of 100 to 200 meters are common for some big game species (Lyon 1983).

The evidence is strong that roads displace some large mammals and certain birds, and that displaced animals may suffer habitat loss as a result. Effects of roads and other linear features on small mammals, songbirds, amphibians, and reptiles are generally less severe, with changes expressed as modifications of habitat that cannot readily be classified as detrimental or beneficial. Roads and their adjacent environment qualify as a distinct habitat and have various species, population, and landscape-scale effects (Baker and Knight 2000). Some research has attempted to describe habitat modifications caused specifically by roads, but most of this work is species- and site-specific (Lyon 1983).

3.8.2 Aquatic Species

No fisheries occur within the project area. The closest perennial stream to the project area is the Pecos River, which is approximately 11 miles away. The Pecos River supports warm water fisheries. Other aquatic organisms may occupy karsts features such as sinkholes, within the project area, but no detailed surveys have been completed.

3.8.3 Sensitive Species

Sensitive species identified in the project area include both special status species and species of special concern. Special status species are defined in Section 3.7.2. In addition, the USFWS and BLM have categories for non-listed species that are believed to be rare or vulnerable. The USFWS designates such species as “species of special concern” and the BLM designates them as “sensitive.” For this analysis, the USFWS species of special concern and BLM sensitive species are referred to collectively as sensitive species.

In accordance with the ESA, the lead agency, the BLM, in coordination with the USFWS, must ensure that any action they authorize, fund, or carry out would not adversely affect a federally listed threatened or endangered species. In addition, it is BLM policy that agency actions do not contribute to the federal listing of any federal candidate species, state-listed species, or sensitive species.

A total of 65 terrestrial and aquatic species (38 special status species and 27 sensitive species) were identified as potentially occurring within the project area (BISON-M 2009, USFWS 2009a). These species, their associated habitats, and their potential for occurrence within the project area are summarized in **Table 3.8-1**. The potential for occurrence was evaluated for each species based on habitat requirements and known distribution. Evaluations determined that 40 terrestrial species (27 special status species and 13 sensitive species) and 9 aquatic species (seven special status species and 2 sensitive species) are unlikely to occur within the project area. Of the remaining 16 terrestrial and aquatic species, 5 are special status species and 11 are sensitive species. All 16 species identified as potentially occurring within the project area are described below (including status).

Mammals

Townsend’s Big-eared Bat (BLM, USFWS). The Townsend's big-eared bat is found throughout New Mexico from low desert to high mountain habitats (Findley et al. 1975). Within its range, this bat is common in deserts, woodlands, and pine forests (AGFD 1993). This species prefers caves, mines, and buildings that maintain stable temperatures and airflow for nursery colonies, bachelor roosts, and winter shelter (AGFD 1993; Findley et al. 1975; Harvey et al. 1999). The bat does not make major migrations and appears to be relatively sedentary, not traveling far from summer foraging grounds to winter hibernation sites (Harvey et al. 1999). Its distribution is correlated with suitable roost and hibernation sites, primarily caves and underground mines. Based on the species’ known distribution and habitat requirements, the potential for this species to occur within the project area is considered to be low.

Cave Myotis (BLM). In New Mexico, the cave myotis can be found in desert floodplains, rocky canyonlands, and desert grassland, which include creosote, brittlebush, paloverde, and cacti (AGFD 1993; Findley et al. 1975; Harvey et al. 1999). Limited roost habitat such as caves, mines and occasionally man-made structures often determine the presence of Cave Myotis (Findley et al. 1975; Harvey et al. 1999). Additionally, the species roosts near water (AGFD 1993). The species is likely to hibernate in the numerous caves located in Lincoln, Chaves, and Eddy counties (Findley et al. 1975). Based on the species’ known distribution and habitat, the potential for this species to occur within the project area is considered moderate.

Big Free-tailed Bat (BLM). The big free-tailed bat prefers to roost in rugged, rocky areas in desert scrub habitats in cliff faces, crevices, and fissures (AGFD 1993; Harvey et al. 1999). Vegetation present within preferred habitat includes creosote bush, blackbrush, sandsage, snakeweed, mesquite, and rabbitbrush (AGFD 1993). The bat is known to also inhabit rocky country, where it roosts in crevices high up on cliff faces but it has also been known to roost in buildings (AGFD 1993; Harvey et al. 1999). Based on the species’ known distribution and habitat requirements, the potential for this species to occur within the project area is considered low.

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Mammals					
Pale Townsend's big-eared bat (*Corynothinus townsendii pallescens*)	BLM; USFWS	This subspecies is primarily a cave dweller and is the bat most dependent upon inactive mines in the southwest. They can be found in desert shrublands, piñon-juniper woodlands, coniferous forests and mixed grass prairies. They will roost in trees, caves, or man-made structures. This is the only subspecies of bat commonly found in New Mexico during winter.	Low. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Cave myotis (*Myotis velifer incautus*)	BLM	Species inhabit mine shafts, tunnels, caves, and even under bridges, in desert areas of creosote bush, paloverde, brittlebush, and cacti. Even though they are found in xeric areas, they are never more than a few miles from some water source such as tanks, canals, or creeks.	Moderate. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Big free-tailed bat (*Nyctinomops mactotis*)	BLM	This species prefers coniferous and mixed woods and depends on rocky cliffs for roosting. They can be found in piñon-juniper woodland, pine and mixed coniferous forests, desert grassland, and other desert communities. In addition to roosting on rocky cliffs, they also may roost in caves, rock fissures, bridges, and buildings.	Low. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Fringed myotis (*Myotis thysanodes thysanodes*)	BLM	This species occurs in a wide variety of vegetation types including mixed shrub, grassland, sagebrush, piñon-juniper woodland, pine and mixed conifer forests, riparian woodlands, and cropland. They are known to roost in caves, mines, and buildings.	Low. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Long-legged myotis (*Myotis volans interior*)	BLM	Species is found in the encinal zone, sycamore, cottonwood, rabbitbrush, oak savanna, oak woodland, piñon-juniper woodland, chapparal woodland, and coniferous forest.	Low. Because the project area is not located within a forested area, potential for occurrence is very low.	No	Bison-M 2009; Findley et al. 1975
Western small-footed myotis (*Myotis ciliolabrum melanorhinus*)	BLM	Species is found in shortgrass plains, sacaton grassland, sycamore, cottonwood, rabbitbrush, oak savanna, oak woodlands, piñon-juniper woodland, chapparal woodlands, and coniferous forest.	Moderate. Because of the variety of habitats occupied by this species, it could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Yuma myotis (*Myotis yumanensis yumanensis*)	BLM	This species seems to be abundant in deserts, grasslands, and woodlands, and the riparian communities of these zones, from 4,000 to 7,000 feet in elevation. Its distribution is tied to permanent watercourses as it is a water-surface forager.	Moderate. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Grey-footed chipmunk (*Neotamias canipes canipes*)	BLM	This species is most commonly found in forested habitats; however, it also is found in piñon-juniper woodlands, shrublands, and desert communities. Its favorite haunts are downed logs at the edge of clearings. It also occurs in dense stands of mixed timber (Quercus, Pinus, Abies) and on brushy hillsides, particularly where crevices in rocks offer retreats.	None	Yes. This project area does not occur within the known range of this species.	BISON-M 2009; Findley et al. 1975
Black-footed ferret (*Mustela nigripes*)	FE	Species occur in Mixed Shrub habitat type. Closely associated with the prairie dog (specifically black-tailed prairie dog [*Cynomys ludovicianus ludovicianus*]) whose burrows provide excellent retreats for ferrets. The dependency of the black-footed ferret on this food item is so great that reduction in numbers of ferrets is directly related to reduction in prairie dogs.	Low. Potential occurrence would be based on the size and density of any prairie dog colonies that may occur within the project area.	Yes. No prairie dog colonies are currently known to exist within the project area.	BISON-M 2009; Findley et al. 1975: BLM 1997
Black-tailed prairie dog (*Cynomys ludovicianus ludovicianus*)	USFWS	Formerly, this species was widespread and abundant east of the Rio Grande and in southwestern New Mexico. Out of the five prairie dog species, the black-tailed prairie dog is the only one found on the short and mid-grass plains east of the Rockies. Black-tailed prairie dogs avoid areas with tall grass, heavy sagebrush, and other thick vegetation cover	Moderate. Potential habitat for the species does not currently occur within the project area.	Yes. No prairie dog colonies are currently known to exist within the project area.	BISON-M 2009; Findley et al. 1975
Arizona black-tailed prairie dog (*Cynomys ludovicianus arizonensis*)	USFWS; BLM	*See C. l. ludovicianus* for habitat associations.	Low. Potential habitat for the species does not currently occur within the project area.	Yes. No prairie dog colonies are currently known to exist within the project area.	BISON-M 2009

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Swift fox (*Vulpes velox velox*)	USFWS	The species is found in pasture or grassland in short or grass climax or subclimax conditions required for foraging or burrowing.	Low. This species could occur within suitable habitats within portions of the project area.	No	BISON-M 2009; BLM 1997; Findley et al. 1975
Guadalupe pocket gopher (*Thomomys bottae guadalupensis*)	BLM; USFWS	This pocket gopher is known to use almost any habitat that has suitable soils for burrowing. They have been found using moderate and high elevations as well as low desert zones. They have been associated with open canyon woodlands, chaparral, grasslands, and pine forests. The subspecies is essentially nocturnal.	None	Yes. This project area does not occur within known range of this subspecies.	BISON-M 2009
Pecos River muskrat (*Ondatra zibethicus ripensis*)	BLM	Muskrats need a waterway that has a constant and fairly stable source of water. An area that has a good water supply but frequently floods is usually unsuitable because the shallow sloughs and marshes inhabited by the "rats" will silt up.	None	Yes. This project area does not occur within known range of this subspecies.	BISON-M 2009
Birds					
Northern beardless tyrannulet (*Camptostoma imberbe ridgwayi*)	NM-E	This species typically occurs at lower elevations in dense stands of mesquite (*Prosopis* spp.) and associated growth-typically along stream courses. In New Mexico, it summers regularly only in Guadalupe Canyon, Hidalgo County	None	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Common black-hawk (*Buteogallus anthracinus anthracinus*)	NM-T; USFWS	Found in the Southwest in cottonwood (*Populus* spp.) and other woodlands along permanent lowland streams where the principal prey of fish, amphibians, and reptiles is available.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; Johnsgard 1990; NMDGF 2008
Varied bunting (*Passerina versicolor versicolor*)	NM-T	In New Mexico the species is a Neotropical migrant at summers regularly in small numbers, and seems to prefer dense, shrubby vegetation associated with relatively arid canyons.	None.	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; NMDGF 2008
Neotropic cormorant (*Phalacrocorax brasilianus*)	NM-T	This species is a widespread waterbird of Central and South America. Nesting occurs in stands of trees or shrubs in or near water in areas that are free from human disturbance.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	USFWS	The western race of the yellow-billed cuckoo is associated with lowland deciduous woodlands, willow and alder thickets, second-growth woods, deserted farmlands, and orchards.	None.	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009
Bald eagle (*Haliaeetus leucocephalus alascanus*)	NM-T	In New Mexico, the species nests are placed in large cottonwoods or ponderosa pines, typically in the vicinity of water with a good supply of fish and often also in close proximity to concentrations of small mammals with limited disturbance during nesting season.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. Potential occurrence by this subspecies within the project area would be highly unlikely.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Aplomado falcon (*Falco femoralis septentrionalis*)	FE; NM-E	The species requires extensive, contiguous desert grasslands characterized by relatively tall, dense grass cover and scattered yucca (*Yucca* spp.) and mesquite (*Prosopis glandulosa*).	Low. This rare subspecies could occur as a rare migrant; as limited historic records near the project area are known.	Yes. Potential occurrence by this subspecies within the project area would be highly unlikely and would likely be limited to migrating individuals.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997
Peregrine falcon, American (*Falco peregrines anatum*)	NM-T; USFWS	In New Mexico, this subspecies breeds locally in mountain areas and migrates statewide. Nests are often located on cliff faces with an overhanging ledge or rock outcrop.	Low. No falcon nest sites have been identified as occurring within the vicinity of the project area.	Yes. The project area does not occur within suitable nesting habitat for this subspecies. Potential occurrence would be limited to migrating and foraging individuals.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997
Peregrine falcon, Arctic (*Falco peregrines tundrius*)	NM-T; USFWS	This subspecies is a very rare migrant through New Mexico.	Low. This migrant subspecies could potentially forage within suitable habitat within the project area.	Yes. Potential occurrence would be limited to migrating and foraging individuals.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997
Southwestern willow flycatcher (*Empidonax traillii extimus*)	FEw/CH; NM-E	The species occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows (Salix sp.), Baccharis, arrowweed (Pluchea sp.), tamarisk (Tamarix sp.), or other plants are present, often with a scattered overstory of cottonwood (Populus sp.).	None	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008; BLM 1997

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Northern goshawk (*Accipiter gentilis atricapillus*)	BLM; USFWS	The species occurs at elevations where stream conditions provide sufficient permanent moisture for emergent plants, or for a narrow band of deciduous trees and shrubs; at low elevation characterized by cottonwood and sycamore, at mid-elevation by white alder (*Alnus rhombifolia*) and bigleaf maple (*Acer macrophyllum*), and at high elevation by willow.	None	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; Johnsgard 1990
Common ground-dove (*Columbina passerine pallescens*)	NM-E	This low elevation species prefers brushy, well-watered valleys, and frequents riparian woodlands and shrublands, especially mesquite thickets along streams and canyon bottoms. Within New Mexico, it occurs primarily across the southern counties that border Mexico.	None	Yes. This subspecies is extremely unlikely to occur within the project area	BISON-M 2009; NMDGF 2008
Ferruginous hawk (*Buteo regalis*)	BLM	The species is associated with open fields. Sparsely scattered shrubs in conjunction with weedy vegetation dominated about 30% of this habitat. The remaining habitat was dominated by stubble, bare ground, and desert saltgrass. Nest sites include trees, ledges, large rock outcrops, and low cliffs in sagebrush valleys and rolling grasslands.	Low. Nesting and foraging habitat for this species could potentially occur within the project area, but is unlikely.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its distribution in New Mexico.	BISON-M 2000; Johnsgard 1990.
Broad-billed hummingbird (*Cynanthus latirostris magicus*)	NM-T	The species is found primarily in riparian woodlands at low to moderate elevations. In New Mexico, this subspecies is a regular summer resident only in Guadalupe Canyon of southwestern NM (Hidalgo Co.).	None.	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; NMDGF 2008

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Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Lucifer hummingbird (*Calothorax Lucifer*)	NM-T	Habitat use by this species over much of its range seems to center on slopes and adjacent canyons in arid montane areas, especially where there are flowering species such as agaves (*Agave* spp.), ocotillo (*Fouquieria splendens*), and other chaparral-type plants. New Mexico's breeding population of this migratory species is found primarily in the Peloncillo Mountains (Hidalgo Co.).	None.	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008
White-faced Ibis (*Plegadis chihi*)	BLM	The species is generally seen in association with shoreline and marsh habitats that bordered open water. Vegetation within these areas often consisted of cattails and rushes, but other plant species (including occasional woody shrub and tree sp.) were frequently present.	Low. Habitat for this species may potentially exist with the creation of evaporation ponds.	Yes. The potential occurrence by this species would be highly unlikely, based on its known habitat.	BISON-M 2009
Thick-billed kingbird (*Tyrannus crassitostris*)	NM-E	The species requires native broadleaf riparian habitats characterized by mature cottonwoods and sycamores. In New Mexico, it summers regularly only in Guadalupe Canyon, Hidalgo County.	None	Yes. The potential occurrence by this species would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Burrowing owl (*Athene cunicularia hypagaea*)	BLM; USFWS	The species inhabits desert, semi-desert shrubland, grasslands, and agricultural areas. Nesting habitat primarily consists of flat, dry, and relatively open terrain; short vegetation; and abandoned mammal burrow for nesting and shelter.	High. Habitat for this species may potentially exist with the project area.	No	BISON-M 2009;

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status^1	Habitat Information^2	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Mexican Spotted Owl (*Strix occidentalis lucida*)	FTw/CH	Habitat characteristics include high canopy closure, high stand density, a multi-layered canopy, uneven-aged stands, numerous snags, and downed woody matter. These are best expressed in old-growth mixed-conifer forests (usually more than 200 years old). These characteristics may also develop in younger stands that are unmanaged or minimally managed, especially when the stands contain remnant large trees or patches of large trees from earlier stands.	None.	Yes. The project area does not occur within suitable nesting habitat for this subspecies.	BISON-M 2009; BLM 1997
Brown pelican (*Pelecanus occidentalis carolinensis*)	NM-E	The species is usually found in marine habitats in warmer waters in North America; except for the lower Colorado Basin and vicinity, it only rarely occurs inland. The species feeds exclusively on fish, which it usually obtains by diving head-first from heights of up to 20 m.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution in New Mexico.	BISON-M 2009; BLM 1997
Mountain plover (*Charadrius montanus*)	USFWS	Species utilize shortgrass prairies and dry playas dominated by blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) and scattered taller vegetation during the breeding season. The species appears to require some degree of bare ground, which may be provided by livestock grazing, prairie dog (*Cynomyes* spp.) towns, disturbed areas around windmills and water tanks, and barren playas.	Low. This subspecies could potentially occur while foraging during migration through the project area.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution and habitat in New Mexico.	BISON-M 2009; BLM 1997

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Piping plover (*Charadrius melodic circumcinctus*)	FT; NM-T	Species occurs on sandflats or along bare shorelines of rivers, lakes, or coasts. The species, which occupies its breeding grounds from late March to August, nests on beaches in the Great Lakes and Atlantic Coast areas, bare areas on islands in the upper Missouri River system, and patches of sand, gravel, or pebbly mud on the alkali lakes of the northern Great Plains. During the winter, piping plovers use algal, mud, and sand flats along the Gulf Coast.	Low. This subspecies could potentially occur while foraging during migration through the project area.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Lesser prairie chicken (*Tympanuchus pallidicinctus*)	FC; BLM	This species occurs in short- and tall-grass prairie and shrubsteppe with sagebrush and yucca components. Breeding occurs on lek sites (or strutting grounds) that are typically located on sparsely vegetated elevated areas, ridgelines, or hilltops.	Moderate. Lek sites for this species have been documented east of the project area.	No	BISON-M 2009
Loggerhead shrike (*Lanius ludovicianus excubitorides*)	BLM	This species occurs in creosote bush and large succulents (*Ferocactus pringlei*, and *Echinocactus platyaconthus*) habitats in southern New Mexico	High. Nesting and foraging habitat for this species could potentially occur within the project area.	No	BISON-M 2009
Baird's sparrow (*Ammodramus bairdii*)	NM-T; BLM; USFWS	In New Mexico, it is primarily a migrant. This species utilizes short-grass prairie and other grasslands.	Moderate. This winter migrant could potentially occur within the project area within suitable habitat.	No	BISON-M 2009; NMDGF 2008
Black tern (*Chlidonias niger surinamensis*)	BLM; USFWS	Species breeds and feeds in vegetated marshes with some open water.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat.	

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Interior least tern (*Sterna antillarum athalassos*)	FE; NM-E	Species are colonial nesters that prefer a flat, sandy substrate essentially devoid of vegetation, on which they place their nest scrapes. Terns were found summering at Brantley Reservoir in 2002 and 2003, and were documented nesting there in 2004.	Low. This subspecies could potentially occur while foraging during migration through the project area.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution in New Mexico.	BISON-M 2009; NMDGF 2008; BLM 1997
Bell's vireo (*Vireo bellii*)	NM-T; USFWS	Species occurs in dense shrubland or woodland along lowland stream courses, with willows (*Salix* spp.), mesquite (*Prosopis* spp.), and seepwillows (*Baccharis glutinosa*) being characteristic plant species.	None	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Gray vireo (*Vireo vicinior*)	NM-T	Species is found in arid juniper woodlands on foothills and mesas, these most often associated with oaks and usually in habitat with a well-developed grass component.	Low. This species could potentially occur within the project area as a migrant.	No	BISON-M 2009; NMDGF 2008
Reptiles					
Western river cooter (*Pseudemys gorzugi*)	NM-T	Primarily a stream species, preferring waters with slow to moderate current, firm bottoms, and abundant aquatic vegetation.	None	Yes. The project does not occur within the known range or habitat for this species.	BISON-M 2009; Degenhardt et al. 1996
Texas horned lizard (*Phrynosoma cornutum*)	BLM	This is a species of open deserts and grasslands with sparse vegetation. Sometimes associated with prairie dog towns. Individuals may bury themselves in loose soils that are sandy, loamy, or rocky and will hide under rocks.	Moderate to High. This species could occur within suitable habitats within portions of the project area.	No	BISON-M 2009; Degenhardt et al. 1996

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Sand dune lizard (*Sceloporus arenicolus*)	FC; NM-T; BLM	Confined to areas of shinnery oak - sand dunes and their peripheries, where the uneven sandy terrain and wind-created blowouts are essential habitat requirements.	Moderate. This species has been documented as occurring near the project area.	No	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008
Mottled rock rattlesnake (*Crotalus Lepidus Lepidus*)	NM-T	This species prefer steep, rugged mountainous areas or desert canyons and hillsides. Their primary threat is from collecting.	None.	Yes. The project does not occur within the known range or habitat for this subspecies.	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008
Grey-banded kingsnake (*Lampropeltis alterna*)	NM-E	The species does not occur much higher in elevation than the lower limit of the juniper zone. It prefers rocky igneous or limestone areas with desert vegetation. Occurs in the southern end of the Guadalupe Mountains	None	Yes. The project does not occur within the known range or habitat for this species.	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008
Western ribbon snake (*Thamnophis proximus diabolicus*)	NM-T	Favored habitats in New Mexico center on streams, ponds, marshes, and even some stocktanks, rarely found away from permanent water sources. It may be found among the dense streamside vegetation, often basking on overhanging branches.	None	Yes. The project does not occur within the known range or habitat for this subspecies.	BISON-M 2009; Degenhardt et al. 1996
Plainbelly water snake (*Nerodia erythrogaster transversa*)	NM-E	This is a semi-aquatic snake restricted to rivers, irrigation ditches, and rocky intermittent streams with abundant fish and frogs. Often hides in dense streamside vegetation.	None.	Yes. The project does not occur within the known range of this subspecies.	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Fish					
Headwater catfish (*Ictalurus iupus*)	BLM; USFWS	This species occupies clear temperate waters generally with a moderate gradient in headwater streams, or in fluctuating tailwaters of dams in the Pecos River.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009
Greenthroat darter (*Etheostoma lepidum*)	NM-T; USFWS	The species occurs in swift-flowing streams and springs, especially vegetated riffle areas with gravel and rubble substrates.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999
Pecos gambusia (*Gambusia nobilis*)	FE; NM-E	The species is found mainly in ponded habitats and gypsum sink holes on Bitter Lake NWR and Blue Spring.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; BLM 1997; Propst 1999
Bigscale logperch (*Percina macrolepida*)	NM-T	Species occurs in deep rivers, preferably with a strong current and rubble-gravel substrate; however, it is also found in rivers with nearly imperceptible flow and in impoundments	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999
Pecos pupfish (*Cyprinodon pecosensis*)	NM-T; USFWS	The Pecos pupfish is found in a variety of habitats from saline springs and gypsum sinkholes to desert streams with highly fluctuating conditions.	None	Yes. Saline habitat is known to occur within and near the project area but there is no perennial water body and it is not known to occur.	BISON-M 2009; NMDGF 2008; BLM 1997; Propst 1999

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Grey redhorse (*Moxostoma congestum*)	NM-T; USFWS	The species is most commonly found in deep, slow-velocity water over a variety of substrates (most commonly silt or limestone bedrock). Most notably in the Pecos and Black rivers.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Prost 1999
Pecos bluntnose shiner (*Notropis simus pecosensis*)	FTw/CH; NM-T	The species mainly occurs in pool and run mesohabitats within wide, shallow, sand-bed reaches of the Pecos River. Substrates are largely shifting sand and small gravel.	None	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; NMDGF 2008; BLM 1997; Propst 1999
Rio Grand shiner (*Notropis jemezanus*)	BLM; USFWS	Inhabits large open rivers with laminar flows and a minimum of aquatic vegetation and larger streams with gravel, sand or rubble bottoms which are sometimes overlain with silt	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009;
Blue sucker (*Cycleptus elongates*)	NM-E; BLM; USFWS	This species frequently found in smooth, hard-bottomed reaches of larger streams where current velocity is rapid and deep. Known to occur in the Pecos River from north of Carlsbad downstream to the New Mexico/Texas border and the lower reaches of the Black River	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999
Mexican tetra (*Astyanax mexicanus*)	NM-T	The species tends to be more common in low-velocity pool habitats in small streams and spring systems.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Invertebrates					
Texas hornshell (*Popenaias popeii*)	FC; NM-E	Species occurs only in larger streams, with variable substrates. The species imbeds itself in softer bottoms, exposing only the siphonal areas in such situations. In rocky sites, it lodges itself in cracks and crevices. Currently only known to occur in the lower Black River.	None	Yes. Mesic habitats occupied by this species would not be affected within the project area.	BISON-M 2009; NMDGF 2008
Pecos springsnail (*Pyrguopsis pecosensis*)	NM-T; BLM	Species is endemic to two perennial tributaries of the Black River. Species lives within a few meters of the brook issuing from Blue Springs, where it occurs under shelter of dead tree-branches and on damp soil.	None	Yes. Mesic habitats occupied by this species would not be affected within the project area.	BISON-M 2009; NMDGF 2008
Ovate vertigo snail (*Vertigo ovate*)	NM-T	Extant populations are known from mesic habitats of Blue Spring. Species occurs on a mud and pebble substrate in its spring habitat, mainly along the edges of the water. At Blue Spring, the species is most common at the spring source and along the natural channel, which is approximately 2 m in width and 1-2 m in depth	None	Yes. Mesic habitats occupied by this species would not be affected within the project area.	BISON-M 2009; NMDGF 2008
Insects					
Guadalupe Mountains tiger beetle (*Cicindela politula petrophila*)	USFWS	Reported to occur in limestone or calcareous clay areas within the Guadalupe Mountains of southeastern New Mexico and west Texas.	None	Yes. Species is endemic to the Guadalupe Mountains of southwestern Eddy county but not known within the project area.	BISON-M 2009

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Obsolete viceroy butterfly (*Basilarchia archippus obsolete*)	USFWS	Known to occur in open habitats with willow and poplar vegetation in association with streams. Can only bread in areas with the presence of willow and poplar.	None	Yes. The project area does not occur within the known habitat for this species.	BISON-M 2009; NatureServe 2009

[1] Status:

FE = Federally listed as endangered.
FT = Federally listed as threatened.
FEw/CH = Federally listed as endangered with critical habitat.
FTw/CH = Federally listed as threatened with critical habitat.
FC = Federal candidate.
USFWS = USFWS species of concern.
NM-E = State-listed as endangered in New Mexico.
NM-T = State-listed as threatened in New Mexico.
BLM = BLM sensitive: New Mexico State Office (NMSO).

Fringed Myotis (BLM). The fringed myotis occupies a wide range of habitats ranging from desert scrub communities to higher elevation coniferous and pine forests (AGFD 1993; Harvey et al. 1999). Fringed myotis use mines, caves, and buildings for roosting sites (Findley et al. 1975; AGFD 1993; Harvey et al. 1999). The species seems to “prefer oak woodlands, from which it forages out into nearby habitats including low desert, chaparral, and ponderosa pine “(AGFD 1993). Based on the species’ known distribution and preference for woodland habitats, the potential for this species to occur within the project area is considered to be low.

Long-legged Myotis (BLM). “The long-legged myotis primarily inhabits forested mountain regions, where it roosts in trees, rock crevices, cracks and crevices in stream bands and in buildings. It may be found in streamside and arid habitats” (Harvey et al. 1999). Based on the species’ known distribution, the potential for this species to occur within the project area is considered low.

Western Small-footed Myotis (BLM). The western small-footed myotis seems to prefer arid habitats associated with cliffs, talus fields, and prairies with steep riverbanks (Harvey et al. 1999). This distribution mainly includes ponderosa pine habitats, but the species may also be found in low desert up through spruce-fir habitats (Findley et al. 1975). This species roosts in crevices in rock faces and clay banks and may use the spaces beneath and between boulders in talus fields. Hibernation sites include caves and mines (Harvey et al. 1999). Based on the species’ known distribution and habitat, the potential for this species to occur within the project area is considered moderate.

Yuma Myotis (BLM). In New Mexico, the Yuma myotis is a water-surface forager (Findley et al. 1975; AGFD 1993; Harvey et al. 1999). Its distribution is tied to permanent watercourses, usually lower than the coniferous forest zone. The Yuma myotis prefers desert, grassland, woodland, and associated riparian communities, between 4,000 to 7,000 feet in elevation (Findley et al. 1975). Unlike many other bat species, the Yuma myotis is not known to roost in caves or mines, but prefers buildings and under bridges (AGFD 1993). Based on the species’ known distribution, the potential for this species to occur within the project area is considered moderate.

Swift Fox (USFWS). In New Mexico, the swift fox ranges throughout the short- and mid-grass prairie, generally in areas with sparse vegetation (BLM 1997). They are most common where soils support large populations of rodent prey, especially kangaroo rats. Underground burrows are used as shelter (Findley et al. 1975). Based on the species’ known distribution, the potential for this species to occur within the project area is considered low.

Birds

Burrowing Owl (BLM, USFWS). The burrowing owl is a ground-nesting bird that is strongly dependent on the presence of burrows constructed by prairie dogs, ground squirrels, or badgers. Prime burrowing owl habitat must be open, have short vegetation, and contain an abundance of burrows. No burrowing owls have been observed during previous surveys of the project area (CEHMM 2008); however, the potential for this species to occur within the project area is considered to be high.

Lesser Prairie-Chicken (FC, BLM). In southeastern New Mexico, lesser prairie-chickens are found in isolated areas east of the Pecos River in the shinnery oak habitat (BLM 1994; New Mexico LPC/SDL Working Group 2005; BLM 2007b). The EIS associated with the Proposed RMP Amendment (BLM 2007b) states “Lesser prairie-chicken populations south of State Highway 380 in Eddy and Lea counties are rare on BLM properties and surrounding areas; however, there have been sightings of scattered small groups and individuals.”

The BLM Special Status Species Proposed RMP Amendment and EIS (BLM 2007b) identified Core Habitat Areas for the lesser prairie-chicken, known as lek sites, and vegetation and habitat composition. The Core Habitat Areas are composed of habitats required to support stable populations of lesser prairie-chickens, including lekking grounds, nesting habitat, brood-rearing habitat, and wintering habitat (BLM 2007b). The nearest Core Habitat Area is located approximately 4 miles east of the project area.

Figure 3.8-1 shows the proximity of the project area and Caprock pipelines to known lesser prairie-chicken habitat. Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered moderate.

Loggerhead Shrike (BLM). The loggerhead shrike is associated with vegetation types throughout its large range (NMACP 2010). In New Mexico, this species is associated with open country and with short vegetation, including desert grasslands, shrublands, and open woodlands or juniper savannahs (NMACP 2010). Breeding is often associated with isolated trees or large shrubs, while nesting sites can be found in thorny shrubs (NMACP 2010). In desert areas, tall yucca stems are often used as hunting perches. Foraging often occurs in open areas with short grass, but the presence of shrubs is critical (NMACP 2010). Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered moderate to high.

Baird's Sparrow (NM-T, BLM, USFWS). The Baird's sparrow breeds in shortgrass prairies. In New Mexico, it has been found in habitats ranging from desert grasslands in the south to prairies in the northeast, and mountain meadows in the San Juan and Sangre de Cristo mountains (BISON-M 2009). In New Mexico, they are primarily migrants moving through the eastern plains and southern lowlands, but wintering birds also occur locally in grasslands to the west of the project area (NMDGF 2008). Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered moderate.

Grey Vireo (NM-T). The gray vireo prefers open pinyon-juniper woodland or juniper savannahs located along canyons, foothills, and mesas. Most chosen habitats have well developed grass or shrub components (NMACP 2010; NMDGF 2008). In southern New Mexico, the species may associate more with oak or desert shrub species (NMACP 2010). Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered low.

Reptiles

Texas Horned Lizard (BLM). The Texas horned lizard inhabits flat, open, generally dry country with little plant cover, except for bunchgrass and cactus (BISON-M 2009). It can be found in open deserts and grasslands up to 6,000 feet in elevation (Degenhardt et al. 1996). Strictly terrestrial, this lizard can bury itself in loose soil that is sandy, loamy, or rocky (BISON-M 2009). Based on the species' known distribution, the potential for this species to occur within the project area is considered moderate to high.

Sand Dune Lizard (FC, NM-T, BLM). In southeastern New Mexico, the sand dune lizard is restricted to habitats associated with active and semi-stabilized sand dunes (BLM 2007b), and the associated blowouts (open, low-lying areas between active dunes) found between dunes (Working Group 2005). Habitat must support scattered stands of shinnery oak (*Quercus havardii*) and sand sage (Artemisia filifolia) as co-dominated plant species (BLM 2007b). The sand dune lizard is mainly threatened by activities that impact or remove the shinnery oak habitat (Working Group 2005). The species has been found mainly in northeastern Chaves County southward and eastward through eastern Eddy County and southern Lea County (BLM 2007b).

The BLM Special Status Species Proposed RMP Amendment and EIS (BLM 2007b) proposed a Conservation Strategy Planning Area that includes known habitats for the sand dune lizard within southeastern New Mexico. The known distribution includes a mosaic of shinnery oak dunal habitat types within 20 km of an occupied site, measured from the outer edge of that contiguous habitat site (BLM 2007b). The nearest known location of sand dune lizard habitat is approximately 2 miles east of the project area. **Figure 3.8-2** displays the sand dune lizard protected habitat closest to the project area and Caprock pipelines. Based on the species' known distribution, the potential for this species to occur within the project area is considered moderate.

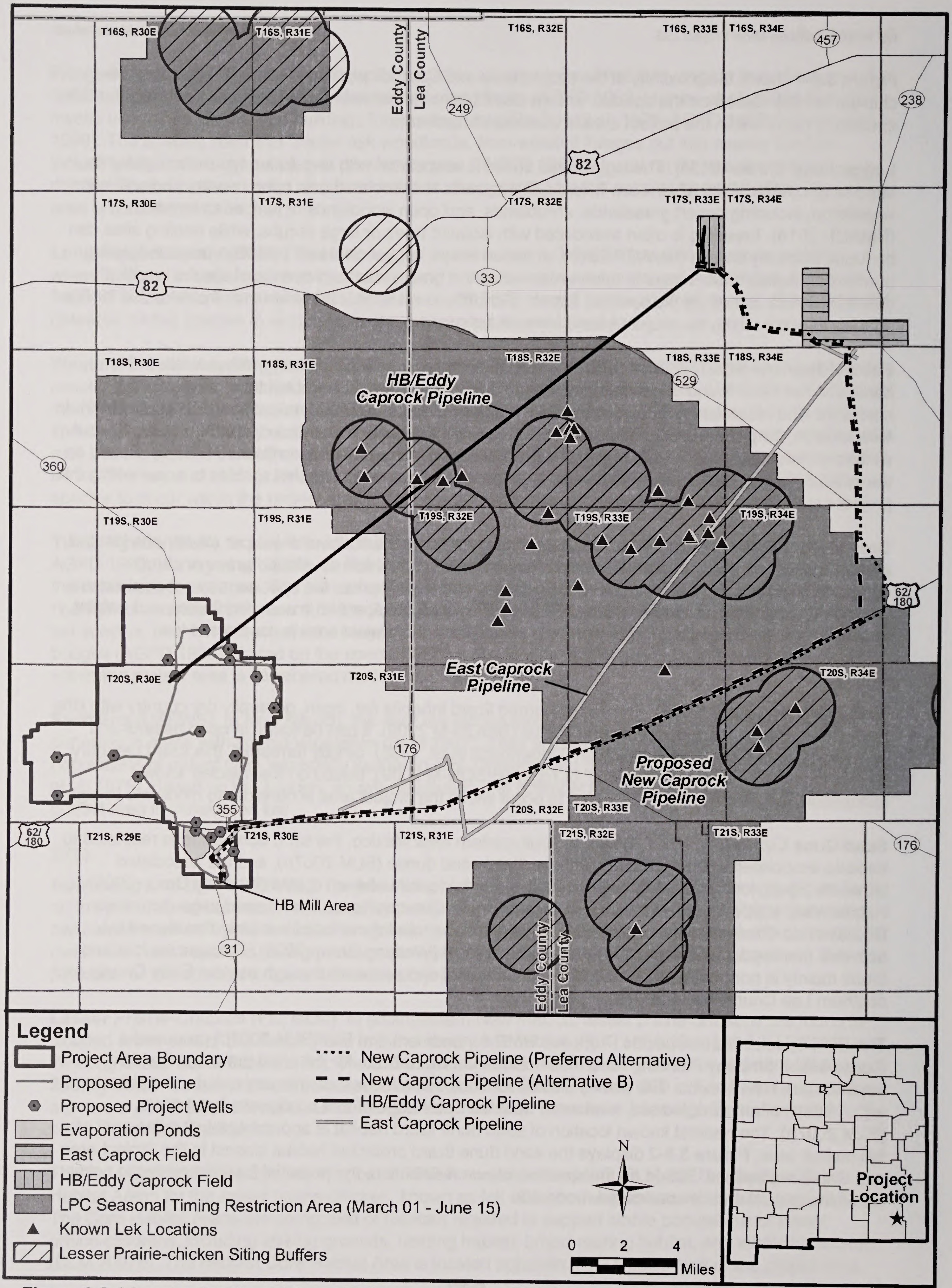


Figure 3.8-1 Lesser Prairie-chicken Habitat near Caprock Pipelines

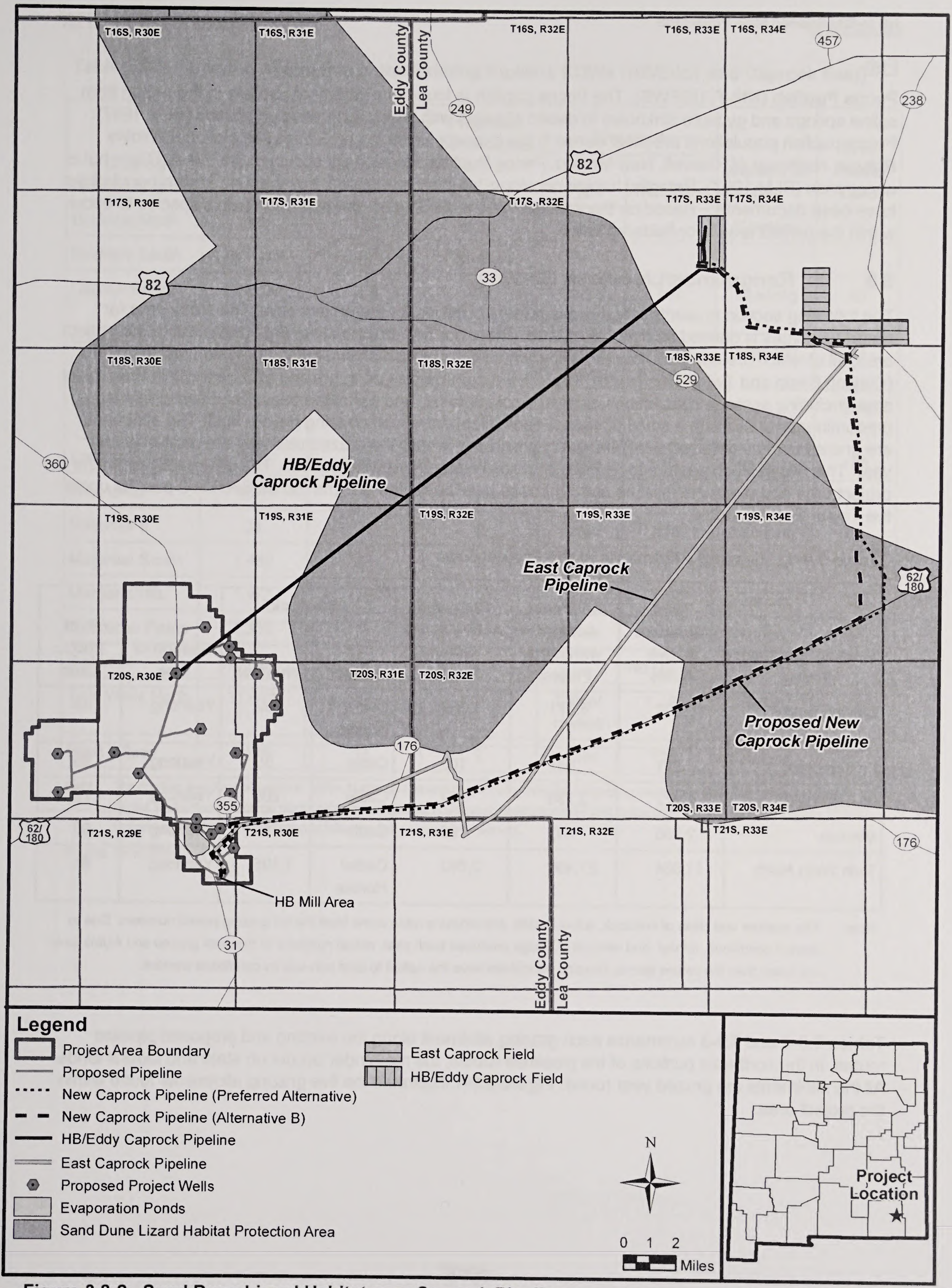


Figure 3.8-2 Sand Dune Lizard Habitat near Caprock Pipelines

Fish

Pecos Pupfish (NM-T, USFWS). The Pecos pupfish is found in a variety of habitats in the region from saline springs and gypsum sinkholes to desert streams with highly fluctuating conditions (BLM 1997). Pecos pupfish populations are most dense in the gypsum sinkholes on Bitter Lake National Wildlife Refuge, northeast of Roswell, New Mexico. Pecos Pupfish occasionally occupies the Pecos River, but is uncommon (BLM 1997). Potential habitat occurs within the project area; however, no known populations have been documented. Based on the species' known distribution, the potential for this species to occur within the project area is considered low.

3.9 Rangelands/Livestock Grazing

The following section presents range management activities for the project area. The study area for range resources is defined as the project area. There are five grazing allotments that occur in the project area, all of which are cattle allotments; while two allotments also show saddle horses on the permit (Clayton Basin and Twin Wells North). **Table 3.9-1** summarizes each grazing allotment within the project area, including acreage calculations, current stocking rates, and permitted uses. Land ownership is predominantly public with a small portion of each allotment encompassing private land. The allotments are grazed using a deferred rotational grazing scheme, where the grazed pastures are rotated each year. This allows each pasture to recover ungrazed during a growing season. The allotments within the project area and along the existing and proposed pipeline routes are granted as Section 3 permits under the Taylor Grazing Act.

Table 3.9-1 Grazing Allotments in the Project Area

Grazing Allotment Name	Total Allotment Active AUMs	Allotment Acreage within the Project	Projected Active AUMs within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Clayton Basin	10,200	6,771	1,369	Cattle/ Horses	992	Yearlong	85
Fenton Draw	811	887	106	Cattle	69	Yearlong	98
Maroon Cliffs	1,972	2,738	332	Cattle	208	Yearlong	79
Mimosa	2,765	447	55	Cattle	256	Yearlong	90
Twin Wells North	11,664	27,490	2,662	Cattle/ Horses	1,195	Yearlong	81

Note: The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers. Due to market conditions, rainfall, and amount of forage produced each year, actual numbers of livestock grazed and AUMs used are lower than the values above. Grazing permittees have the option to take non-use as conditions warrant.

Tables 3.9-2 and **3.9-3** summarize each grazing allotment along the existing and proposed pipeline routes. In the northeast portions of the pipelines routes, the remainder occurs on state and federal lands. All the allotments are grazed year round. **Figure 3.9-1** illustrates the five grazing allotments found within the project area.

Table 3.9-2 Grazing Allotments in the Existing Pipeline ROWs (HB/Eddy and Caprock East)

Grazing Allotment Name	Total Allotment Active AUMs	Allotment Acreage along the Pipeline	Projected Active AUMs within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Buckeye North	48	38	<1	Cattle	4	Yearlong	100
Buckeye South	No Data	33	No Data				
Clayton Basin	10,200	72	13	Cattle/ Horses	992	Yearlong	85
Halfway	3,576 cattle/ 40 horses	15	3	Cattle/ Horses	359 cattle/ 4 horses	Yearlong	83
Laguna Tonto	11,641	21	10	Cattle/ Horse	Varies	Yearlong	Varies
Laguna Totson	840	9	2	Cattle	70	Yearlong	100
Little Lake	691	4	<1	Cattle	80	Yearlong	72
Maljamar II	24	26	2	Cattle	178	Yearlong	68
Maljamar South	1,452	34	3	Cattle	2	Yearlong	100
Maroon Cliffs	1,972	25	2	Cattle	208	Yearlong	79
Querecho Plains	1,339	9	1	Cattle	115	Yearlong	97
Salt Lake	No Data	34	No Data				
Twin Wells North	11,664	32	3	Cattle/ Horses	1,195	Yearlong	81
West Bilbrey	1,176	15	2	Cattle	121	Yearlong	81

Note: The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers. Due to market conditions, rainfall, and amount of forage produced each year, actual numbers of livestock grazed and AUMs used are lower than the values above. Grazing permittees have the option to take non-use as conditions warrant.

Source: BLM 2010c.

Table 3.9-3 Grazing Allotments in the Proposed Caprock Pipeline ROW

Grazing Allotment Name	Total Allotment Active AUMs (ac.)	Allotment Acreage along the Pipeline	Projected Active AUMs within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Buckeye North	48	30	<1	Cattle	4	Yearlong	100
Buckeye South	No Data	24	No Data	No Data	No Data	No Data	No Data
Clayton Basin	10,200	29	5	Cattle/ Horses	992	Yearlong	85
Halfway	3,576 cattle/ 40 horses	16	4	Cattle/ Horse	359 cattle/ 4 horses	Yearlong	83
Hart Ranch	379	38	1	Cattle	117	Yearlong	27
Laguna Tonto	11,641	21	11	Cattle/ Horse	Varies	Yearlong	Varies
Laguna Totson	840	13	4	Cattle	70	Yearlong	100
Maljamar II	24	1	<1	Cattle	178	Yearlong	68
Salt Lake	No Data	18	No Data	No Data			
Twin Wells North	11,664	24	2	Cattle/ Horses	1,195	Yearlong	81

Note: The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers. Due to market conditions, rainfall, and amount of forage produced each year, actual numbers of livestock grazed and AUMs used are lower than the values above. Grazing permittees have the option to take non-use as conditions warrant.

Source: BLM 2010c.

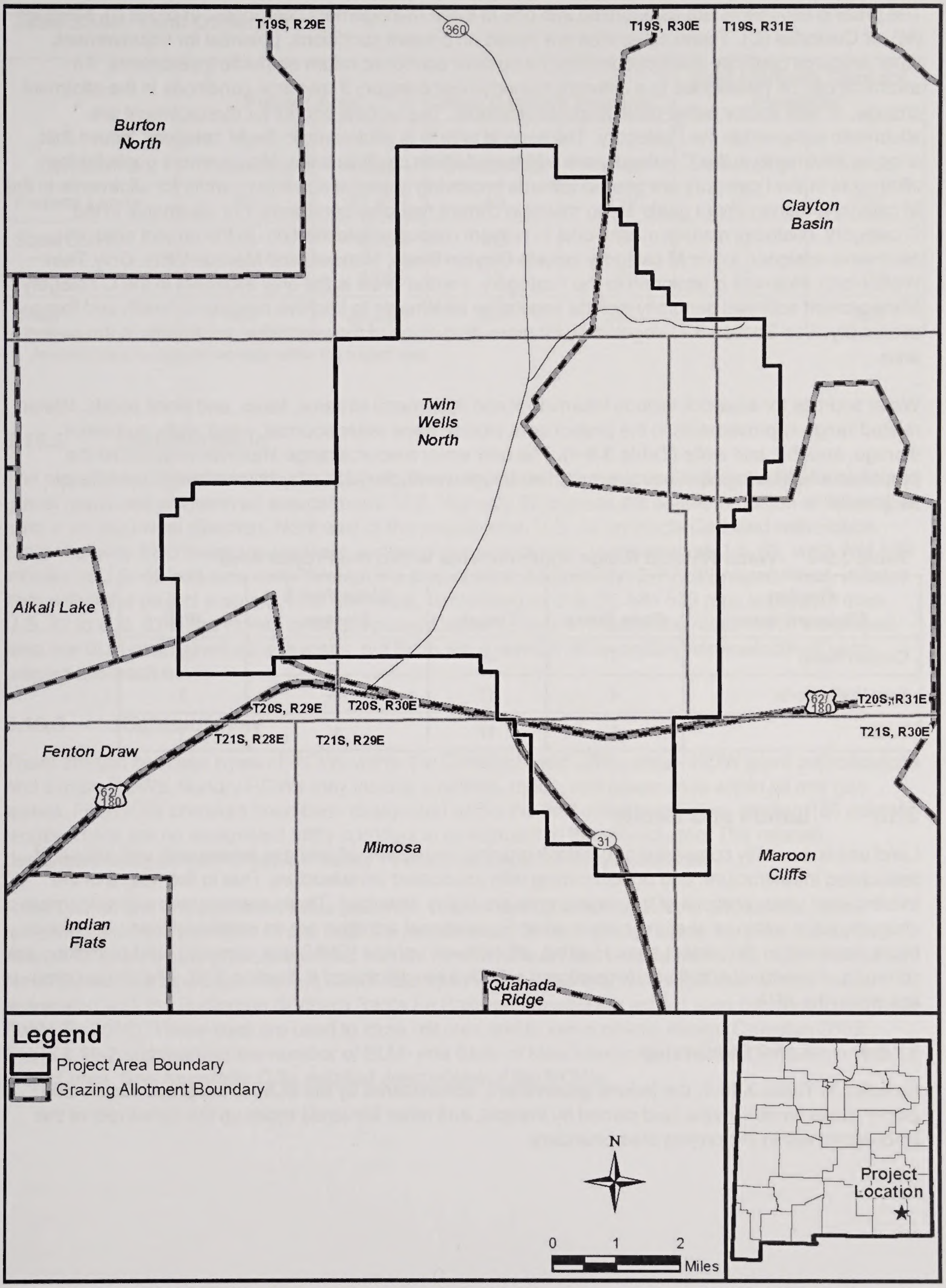


Figure 3.9-1. Grazing Allotments in the Project Area

The grazing allotments are categorized into one of three management categories: Improve (I), Maintain (M), or Custodial (C). These categories are based on present conditions, potential for improvement, other resource conflicts, and opportunities for positive economic return on public investments. An allotment can be reassigned to a different management category if resource conditions in the allotment change, or new and/or better data becomes available. The highest priority for management are allotments assigned to the I category. The second priority is allotments in the M category. Issues that arise on allotments in the C category are addressed when conflicts arise. Management goals for the allotments in the I category are geared towards improving resource conditions, while for allotments in the M category, management goals are to maintain current resource conditions. For allotments in the C category, custodial management works to prevent resource deterioration. In the project area, the allotments assigned to the M category include Clayton Basin, Mimosa, and Maroon Cliffs. Only Twin Wells North allotment is assigned to the I category. Fenton Draw is the only allotment in the C category. Management activities generally include vegetation treatments to improve rangeland health and forage availability. See Section 3.7, Vegetation, for more discussion of the vegetative treatments in the project area.

Water sources for livestock include intermittent and ephemeral streams, lakes, and stock ponds. Water related range improvements in the project area include base water sources, water wells and water storage, troughs, and wells (**Table 3.9-4**). The only water resource range improvements within the proposed and existing pipeline routes are two troughs in Buckeye South and one trough in Halfway allotments.

Table 3.9-4 Water Related Range Improvements within the Project Area

Grazing Allotment Name	Base Water	Trough	Water Well & Storage	Well
Clayton Basin	1	—	1	—
Twin Wells North	4	17	—	1
Total	**5**	**17**	**1**	**1**

3.10 Lands and Realty

Land use is currently comprised of livestock grazing; recreation, oil and gas leases with well sites and associated infrastructure, and potash mining with associated infrastructure. Due to the nature of the existing land uses, portions of the project area are highly disturbed. There are no areas with wilderness characteristics within or near the project area. Recreational activities are an additional land use, which takes place within the project area. Hunting, off-highway vehicle (OHV) use, camping, and picnicking are common recreational activities. Recreational activities are discussed in Section 3.11. The project area lies within the SPA.

3.10.1 Land Ownership

As noted in **Table 3.10-1**, the federal government, administered by the BLM, is the predominant land owner. State lands, private land owned by Intrepid, and other fee lands make up the remainder of the landowners within the project area boundary.

Table 3.10-1 Land Ownership

Ownership	Project Area		New Caprock Pipeline[1]		East-HB/Eddy Caprock Pipelines[1]	
	% Ownership	Acres	% Ownership	Acres	% Ownership	Acres
Federal Lands	82	31,439	45	119	61	237
State Lands	13	4,954	40	105	22	87
Private	5	2,060	15	38	17	64
Total	100	38,453	100	262	100	388

[1] Analysis does not include acreage within the project area.

3.10.2 Transportation

The project area is transected by one U.S. highway, two state highways, and numerous BLM maintained gravel roads and unimproved access roads. U.S. Highway 62 crosses the southern portion of the project area in an east-west direction. Northeast of the project area, U.S. 62 connects Carlsbad with Hobbs. State Highway 31 crosses the southern portion of the project area, terminating at U.S. 62, while NM 380 initiates at U.S. 62 and runs north through the project area. Additionally, CR 222/Shugart Road, initiates from within the project area and runs northwest, terminating at U.S. 82. NM 529 runs southwest from U.S. 82 to U.S. 62 in the vicinity of the proposed Caprock pipeline. Most of the roads within the project area are BLM-maintained access roads, but there are a number of secondary non-maintained user-created two-track roads.

3.10.3 Rights-of-Way

There are two common types of ROWs within the Carlsbad Field Office area—ROW grant authorizations and sundry ROWs. Sundry ROWs may include pipelines, roads, and power lines within oil and gas leases. Five ROW corridors have been designated within the field office jurisdiction, totaling 185 miles in length. There are no designated utility corridors in or adjacent to the project area. The nearest designated utility corridor is approximately 15 miles northwest of the project area.

ROWs for oil and gas pipelines, water pipelines, roads, fiber optic cable, electric power lines, and telephone lines are permitted in and near the project area. Several utilities within the project area that may be affected by the proposed project include three overhead power lines owned by Xcel, two buried New Mexico Gas pipelines, and one AT&T fiber optic line. Additionally, two short-line railroad tracks associated with the Burlington Northern Santa Fe Railroad transect the project area (Burlington Northern Santa Fe 2010). These lines are used to store rail cars and to serve nearby mines (Cranston 2009). **Table 3.10-2** summarizes the number of BLM- and State of New Mexico-permitted ROWs within the project area. See **Appendix C** for detailed descriptions of the ROWs.

Table 3.10-2 Rights-of-Way within Project Area

ROW Use	Total Within Project Area (no. BLM/no. NM[2])	Active (no. BLM/no. NM)	Inactive (no. BLM/no. NM)
Oil Pipeline[1]	11/1	6/1	5/0
Gas Pipeline	56/13	42/13	14/0
Road	60/2	52/2	8/0
Railroad	3/3	3/3	0/0
Power line	51/15	43/15	8/0
Water	14/0	11/0	3/0
Telephone	10/3	7/9	2/0
Fiber Optic	4/1	4/1	0/0
Total	209/38	169/38	40/0

[1] A total of 5 ROWs are listed as both oil and gas pipelines. In this table they have been included under Oil Pipeline to avoid double-counting.

[2] NM refers to state ROWs.

3.11 Recreation

Recreation in the project area is currently comprised of OHV activities as well as hunting, camping, and picnicking. All public lands in the BLM Carlsbad Field Office Area are designated as limited, open, or closed to OHV activities. All of the BLM-administered land in the project area is designated as open to OHV use.

A portion of the Hackberry Lake Special Recreation Management Area (SRMA) covers the northeastern part of the project area (see **Figure 3.11-1**). This recreation area totals 55,800 acres, and is open for intensive use of motorcycles, sand dune buggies, and other OHVs, getting frequent use year-round. The Desert Rough Riders hold a Special Recreation Use Permit in the Hackberry Lake OHV Area to hold a 2-day motocross and all terrain vehicle race each October. There is a parking area to the north that is used as a starting point for the race (Younger 2009).

Approximately, 16,178 acres or 29 percent of the OHV area lies within the project area boundary. The recreation area overlaps approximately 40 percent of the project area. Trails within the recreation area typically consist of many turns and steep hill climbs. Camping is allowed in the Hackberry Lake SRMA and facilities include picnic tables, shelters, fire rings, vault toilets, and parking areas at two different locations (trails on the east side and dune complex on the west side of the SRMA).

Hunting is another recreational activity that may take place within the project area. A variety of species, from big game to varmints and upland birds, may be hunted in the project area (Younger 2009).

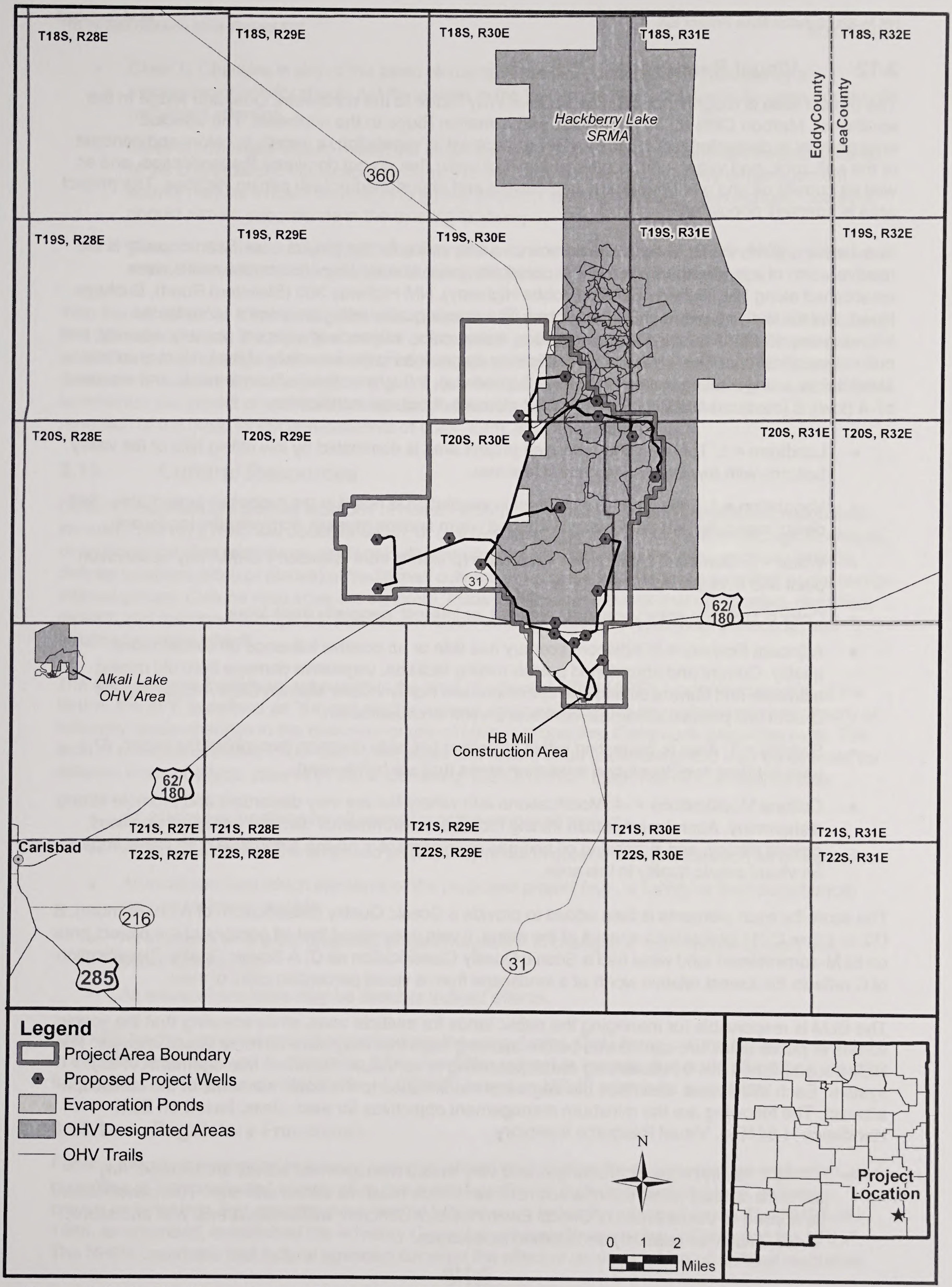


Figure 3.11-1 Hackberry Lake SRMA within the Project Area

3.12 Visual Resources

The project area is roughly bounded by Fade-A-Way Ridge to the northwest, Quahada Ridge to the southwest, Maroon Cliffs to the southeast, and Nimenim Ridge to the northeast. The affected environment is characterized by little variety or contrast in vegetation, a variety in colors and contrast of the soil, rock, and vegetation, scattered pools of water that do not dominate the landscape, and as well as current oil and gas operations, and current and abandoned potash mining facilities. The project area is sparsely populated.

In a January, 2011, the BLM conducted a scenic quality rating for the project area. Scenic quality is the relative worth of a landscape from a visual perception point of view. Key observation points were established along NM Highway 62/180 (Hobbs Highway), NM Highway 360 (Bluestem Road), Buckeye Road, and the outlying areas of Shugart Road. The scenic quality rating provides a score for the following scenic elements: landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications. The scores and descriptions determined in the inventory of the project area are listed below, using a rating system of 1 (low), 3 (medium), 5 (high) on the first six elements and a score of -4 (low), 0 (medium) and 2 (high) on the last element of cultural modification.

- Landform = 1: Terrain in the proposed project area is dominated by low rolling hills or flat valley bottoms with few interesting natural features.
- Vegetation = 1: Little variety or contrast in vegetation is noted in the proposed project area. Salt cedar, mesquite, shinnery oak, yucca, and warm season grasses dominate the landscape.
- Water = 5: Dominant factor in the landscape (primarily from Hackberry SRMA key observation point and Shugart Road.
- Color = 1: Subtle color variations, contrast, or interest; generally mute tones.
- Adjacent Scenery = 0: Adjacent scenery has little or no positive influence on overall visual quality. Current and abandoned potash mining facilities, vegetative damage from old mining activities, and current oil and gas operations are highly visible. Maroon Cliffs Archaeological District is a positive scenic element and a VRM III classification.
- Scarcity = 1: Area is interesting within its setting but fairly common throughout the region. The area contains two developed recreation areas that are highly used.
- Cultural Modifications = -4: Modifications add variety but are very discordant and promote strong disharmony. Abandoned potash mining facilities, environmental damage from past practices, caliche mining, and increasing oil and gas development is having a negative cumulative impact on visual scenic quality in this area.

The score for each elements is then added to provide a Scenic Quality Classification of A (19 or more), B (12 to 18) or C (11 or less). As a result of the rating, it was determined that all portions of the project area on BLM-administered land were had a Scenic Quality Classification as C. A Scenic Quality Classification of C reflects the lowest relative worth of a landscape from a visual perception point of view.

The BLM is responsible for managing the public lands for multiple uses, while ensuring that the scenic values of public lands are considered before allowing uses that may have adverse visual impacts. The BLM accomplishes this by classifying areas according to its Visual Resource Management (VRM) system. Each VRM class describes the degree of modification to the basic elements of the landscape allowed. The following are the minimum management objectives for each class, based on BLM Handbook H-8410-1, Visual Resource Inventory.

- Class I: Natural ecological changes and very limited management activity are allowed. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to Visual Areas of Critical Environmental Concern, wilderness areas, wild and scenic rivers, and other relatively undisturbed landscapes.

- Class II: Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the landscape. A contrast may be seen but should not attract attention.
- Class III: Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Contrasts to the basic elements caused by a management activity may be evident and begin to attract attention in the landscape. The changes, however, should remain subordinate in the existing landscape.
- Class IV: Contrasts may attract attention and be a dominant feature in the landscape in terms of scale. However, the changes should repeat the basic elements of the landscape.

With the exception of 13 acres located near the southeast project boundary between the Hobbs highway and the railroad track, the proposed project is located on public lands managed as VRM Class IV in which the level of change of the characteristic landscape can be high. Management activities may dominate the view and be the primary focus of viewer attention. However, every attempt should be made to minimize the impact of activities through careful location of facilities, minimal disturbance, and repetition of the basic landscape elements of color, form, line, and texture.

3.13 Cultural Resources

Cultural resources are definite locations of human activity, occupation, or use identifiable through field inventory (survey), historical documentation, or oral evidence. The term includes archaeological, historic, or architectural sites, structures, or places with important public and scientific uses, and may include definite locations (sites or places) of traditional, cultural, or religious importance to specified social and/or cultural groups. Cultural resources are concrete, material places and things that are located, classified, ranked, and managed through the BLM's Land Use Planning system of identifying, protecting, and utilizing for public benefit.

The analysis area for cultural resources is the area of potential effect (APE). Under Section 106 of the NHPA, the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR 800.16[d]). The APE should include:

- All alternative locations for all elements of the proposed project.
- All locations where the proposed project may result in ground disturbance such as tailings piles.
- All locations from which elements of the proposed project (e.g., a facility or land disturbance) may be visible or audible.
- All locations where the proposed project may result in changes in traffic patterns, land use, public access, etc.
- All areas where there may be direct or indirect effects.

The APE for the proposed project encompasses the project area. Only those cultural resources located in the APE were reviewed to determine if they would be subject to impacts that could affect their eligibility for the National Register of Historic Places (NRHP) based on NRHP criteria for evaluation.

3.13.1 Regulatory Framework

Federal historic preservation legislation provides a legal environment for documentation, evaluation, and protection of prehistoric and historic sites that might be affected by federal undertakings, including private undertakings that operate under federal license or on federally managed lands. The NHPA of 1966, as amended, established the Advisory Council on Historic Preservation (ACHP) and the NRHP. The NHPA mandates that federal agencies consider the effect of an undertaking on cultural resources that are listed or are eligible for listing on the NRHP. Section 106 of the NHPA and its implementing regulations (36 CFR 800) establishes a four-step review process by which such resources are considered. The four steps are as follows:

1. Initiate the Section 106 process by establishing the undertaking, defining the APE, and consulting with the appropriate agencies.
2. Identify NRHP-eligible sites, through inventory and evaluation.
3. Apply the criteria to determine adverse effects.
4. If adverse effects will occur, then take appropriate steps to avoid or mitigate those effects.

Cultural resources that are listed or eligible for listing on the NRHP are referred to as historic properties.

The National Programmatic Agreement (NPA) among the BLM, ACHP, and National Conference of State Historic Preservation Offices regarding the manner in which the BLM will meet its responsibilities under the NHPA is the National BLM authority for meeting requirements of the NHPA. Day-to-day operations are based on the protocols developed by the local BLM offices in each state. In New Mexico, the Protocol Agreement (2004) between the BLM and New Mexico SHPO defines how the BLM and SHPO will interact and cooperate under the NPA, and provides direction for implementing the NHPA.

3.13.2 Eligibility Criteria for Listing Cultural Resources on the NRHP

The NRHP, maintained by the NPS on behalf of the Secretary of the Interior, is the nation's inventory of significant cultural resources. The NPS has established three main standards that a resource must meet to qualify for listing on the NRHP: age, integrity, and significance. To meet the age criteria, a resource generally must be at least 50 years old. To meet the integrity criteria, a resource must "possess integrity of location, design, setting, materials, workmanship, feeling, and association" (36 CFR 60.4). Finally, a resource must be significant according to one or more of the following criteria:

- Criterion A: be associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B: be associated with the lives of persons significant in our past.
- Criterion C: embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D: have yielded, or may be likely to yield, information important in prehistory or history.

3.13.3 Culture History

The proposed project falls within the Southeastern New Mexico Archaeological Region. This region contains the following cultural/temporal periods: Paleoindian (ca. 12,000 – 6,200 B.C.), Archaic (ca. 6,200 B.C. – A.D. 500), Ceramic (ca. A.D. 500 – 1540), Protohistoric and Spanish Colonial (ca. A.D. 1400 – 1821), and Mexican and American Historical (ca. A.D. 1822 to early 20th Century). For a full discussion of the cultural/temporal periods, the reader is referred to Living on the Land: 11,000 Years of Human Adaptation in Southeastern New Mexico, An Overview of Cultural Resources in the Roswell District (Sebastian and Larralde 1989).

3.13.4 Cultural Resources Investigations

To date, 12 Class III cultural resources inventories associated with the proposed project have been conducted within proposed disturbance areas. In addition to the inventories, a treatment plan was developed for three NRHP-eligible sites located during inventory of the proposed evaporation ponds. Of the 12 cultural resources inventories, 7 encountered archaeological sites. The following are brief summaries of the seven inventories in which archaeological sites were encountered.

In August 2007, a Class III cultural resources inventory of two proposed solution wells (IP-017 and IP-018) and associated access roads was conducted for the proposed project (Walker and Dello-Russo 2007). Site LA157681, a prehistoric lithic scatter of unknown cultural affiliation, was documented during the inventory. The site was recommended as ineligible for the NRHP; no additional investigation of the site is necessary.

Between October 2007 and March 2008, three proposed monitor wells (IP-015, IP-016, and IP-019) and associated access roads were inventoried at the Class III level for cultural resources (Walker and Dello-Russo 2008a). During the Class III inventory, one newly recorded segment of a railroad spur along the Atchison, Topeka, & Santa Fe Railroad was located within the access road associated with IP-015, as well as a previously recorded prehistoric lithic scatter (LA36561). The abandoned railroad spur (LA158191) was recommended as ineligible for the NRHP and the prehistoric lithic scatter was recommended as eligible under Criterion D. Subsequent to the inventory, the proposed access road was dropped from consideration and an existing dirt road was chosen as access to the well. Consequently, the NRHP-eligible prehistoric lithic scatter would be avoided by project construction. No additional investigation of the site is recommended.

From October 2007 to March 2008, a Class III cultural resources inventory of three proposed monitor wells (IP-020, IP-022, and IP-030) and associated access roads was completed for the proposed project (Walker and Dello-Russo 2008b). Two newly recorded historic sites and two previously recorded prehistoric sites were located during the inventory. The newly recorded historic sites include a possible camp with several features (LA159881) and an artifact scatter (LA159882). Both sites were recommended as not eligible for the NRHP; no additional investigation of these sites is necessary. The two previously recorded prehistoric sites include an NRHP-eligible lithic, ceramic, and groundstone scatter (LA110823) and an ineligible lithic scatter (LA137355). Due to the presence of the NRHP-eligible prehistoric site within a proposed well location, the orientation of the well pad was realigned to provide maximum distance between construction activities and the site. No additional investigation of the site is necessary; however, an archaeological monitor is recommended during construction of the well.

Between February and May 2008, a Class III cultural resources inventory of the proposed evaporation ponds was conducted for the proposed project (Walker and Dello-Russo 2008c). The inventory located nine newly recorded sites and eight previously recorded sites. Eight of the seventeen sites were recommended as eligible for the NRHP. However, seven of the eight eligible sites are located outside of proposed disturbance associated with construction of the ponds and therefore would not be impacted by project construction. The remaining eligible site (LA109920) and sites LA159599 and LA159601, both of which have undetermined eligibility, are located within proposed disturbance areas and would be adversely affected by construction activities. Site LA109920 is a previously recorded prehistoric lithic and ceramic scatter eligible for the NRHP under Criterion D. Sites LA159599 and LA159601 are newly recorded prehistoric artifact scatters that require test excavations to determine their eligibility to the NRHP. In a letter to the New Mexico State Historic Preservation Officer (SHPO), the BLM recommended additional archaeological work for sites LA109920, LA159599, and LA159601 to mitigate the adverse effects of the proposed project .The New Mexico SHPO subsequently concurred with the BLM recommendations (Nelson 2008).

In January 2009, a treatment plan for sites LA109920, LA159599, and LA159601 was prepared and submitted to the BLM (Lone Mountain 2009a). The treatment plan outlines the procedures for conducting evaluative testing at the three sites and subsequent data recovery, if necessary. The plan also includes a summary of findings to date, description of the general theoretical perspective guiding the work, regional research problems, testable research questions, relevant data needs, field techniques, laboratory and analytical techniques, and curation arrangements.

Evaluative testing at sites LA109920, LA159599, and LA159601 was completed in late fall 2009. Laboratory analysis of the data collected during testing currently is underway. Results of the testing and laboratory analysis will be included in a report and submitted to the BLM and SHPO for review. Recommendations for additional archaeological work (i.e., data recovery) will be determined based on BLM and SHPO review.

In October 2008, a proposed core hole location (IP-40) was inventoried at the Class III level for cultural resources (Walker and Dello-Russo 2008d). As a result of the inventory, one previously recorded site was located outside of the proposed disturbance area. The site (LA30766) was identified as a prehistoric lithic, groundstone, and ceramic scatter, and recommended as eligible for the NRHP under Criterion D. Since the site is located outside of proposed disturbance associated with construction of the core hole, no additional investigation of the site is recommended.

From March to May 2009, a Class III inventory of two proposed monitor wells (IP-024 and IP-025) and associated access roads was conducted for the proposed project (Walker and Dello-Russo 2009). During the inventory, three newly recorded sites were documented and one previously recorded site was updated. The newly recorded sites include a prehistoric lithic scatter (LA163309), multi-component site with a prehistoric lithic, ceramic, and groundstone scatter and historic artifact scatter (LA163310), and historic railroad (LA163311). Site LA163309 (prehistoric lithic scatter) and the prehistoric component of LA163310 were recommended as eligible for the NRHP under Criterion D. Site LA163311 (historic railroad) and the historic component of LA163310 were recommended as ineligible for the NRHP. The one previously recorded site (LA121535) contains a prehistoric lithic and ceramic scatter and is recommended as eligible for the NRHP under Criterion D. NRHP-eligible sites LA163309 and LA121535, and the NRHP-eligible prehistoric component of site LA163310 would be avoided by proposed disturbance; therefore, no additional investigation of these sites is recommended.

Between June and July 2009, a Class III inventory of 153 acres in and around the proposed project area was conducted for a proposed subsidence monitoring program by Intrepid Potash (Lone Mountain 2009b). The monitoring program involves placing metal rods below the surface at designated drill points to measure future ground elevation (subsidence) in and around the proposed project area. One previously recorded site (LA70119), one newly recorded site, and seven isolated occurrences were located during the Class III inventory. Previously recorded site LA70119 is a large prehistoric lithic scatter determined eligible for the NRHP under Criterion D by the New Mexico SHPO in 1998. The newly recorded site (LA163291) is a prehistoric lithic scatter and is recommended as eligible for the NRHP under Criterion D. Both of the NRHP-eligible sites were avoided by placement of the metal rods; no further work is recommended. Isolated occurrences are by definition not eligible for the NRHP; therefore, no further investigation of these isolated finds is recommended.

At this time, no Class III inventories have been conducted for the proposed locations of the mill processing facilities, water pipelines, and utility conveyances associated with the proposed project; all other proposed project components have been inventoried. Inventories of proposed project components not yet inventoried would be completed by a BLM-approved archaeologist prior to project construction. The results of the inventories would be documented in a technical report, which would include the results of the literature search and field survey, a cultural background of the area, descriptions of each site, a historic context to evaluate each site for NRHP eligibility, and management recommendations. The report would be submitted to the BLM for review, and the BLM would consult with the New Mexico SHPO according to the terms of the Protocol Agreement.

3.13.5 Native American Traditional Values

Ethnographic resources are associated with the cultural practices, beliefs, and traditional history of a community. Examples of ethnographic resources include places in oral histories or myths, such as particular rock formations, the confluence of two rivers, or a rock cairn; large areas, such as landscapes and viewscapes; sacred sites and places used for religious practices; social or traditional gathering areas, such as dance areas; natural resources, such as plant materials or clay deposits used for arts, crafts, or ceremonies; and places and natural resources traditionally used for non-ceremonial uses, such as trails or camping locations.

3.13.5.1 Regulatory Framework

Federal law and agency guidance require the BLM to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by BLM undertakings. This consultation includes the identification of places (i.e., physical locations) of traditional cultural importance to Native American tribes. Places that may be of traditional cultural importance to Native American people include, but are not limited to, locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules or practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes, may be taken. Some of these locations may be considered sacred to particular Native American individuals or tribes.

In 1992, the NHPA was amended to explicitly allow that “properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined to be eligible for inclusion on the NRHP.” If a resource has been identified as having importance in traditional cultural practices and the continuing cultural identity of a community, it may be considered a Traditional Cultural Property (TCP). The term “traditional cultural property” first came into use within the federal legal framework for historic preservation and cultural resource management in an attempt to categorize historic properties containing traditional cultural significance. National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker and King 1998) defines a TCP as “one that is eligible for inclusion on the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community.” To qualify for nomination to the NRHP, a TCP must be more than 50 years old, must be a place with definable boundaries, must retain integrity, and must meet certain criteria as outlined for cultural resources in National Register Bulletin 15 (NPS 1995).

In addition to NRHP eligibility, some places of cultural and religious importance to the tribes also must be evaluated to determine if they should be considered under other federal laws. These include, but are not limited to, the NAGPRA, American Indian Religious Freedom Act (AIRFA) of 1978, Archaeological Resources Protection Act (ARPA) of 1979, and EO 13007 (Sacred Sites) of 1996.

3.13.5.2 Native American Consultation

The BLM conducts Native American consultation regarding TCPs and sacred sites during land use planning and its associated environmental impact review. In addition, during the oil and gas lease sale process, Native American consultation is conducted to identify TCPs and sacred sites whose management, preservation, or use would be incompatible with oil and gas or other land use authorizations. With regard to TCPs, the BLM has very little knowledge of tribal sacred or traditional use sites, and these sites may not be apparent to archaeologists performing surveys in advance of drilling. However, to date, no TCPs or sacred sites have been identified in the vicinity of the proposed project area.

In January 2009, the BLM submitted a copy of the above-described treatment plan to the Mescalero Apache Tribe, Apache Tribe of Oklahoma, Comanche Indian Tribe, Pueblo of Isleta, Kiowa Tribe of Oklahoma, Ysleta del Sur Pueblo, and Hopi Tribal Council for review. To date, only the Hopi Tribe and Pueblo of Isleta have responded. In a letter dated February 23, 2009, the Hopi Tribe stated their appreciation for the continued opportunity to provide input on the proposed project, and requested if prehistoric human remains are inadvertently discovered during project construction that the Tribe be notified prior to any proposed excavation (Kuwanwisiwma 2009). In addition, the Tribe requested copies of the cultural resources report for review and comment. In a letter dated February 19, 2009, the Pueblo of Isleta stated that the proposed project would not impact religious or cultural sites; however, in the event of unanticipated discoveries during project construction, the pueblo would appreciate being advised of such findings (Benavides 2009).

On February 1, 2010, the BLM sent a letter to the Ysleta del Sur Pueblo, which described the proposal from Intrepid Potash, Inc. to transform their existing HB Mine into a Solution Mining operation (Stovall 2010). Attached to the letter were a detailed description of the proposed project and a map of the project area. In addition, the BLM included a discussion of previous archaeological investigations in the project area and requested information regarding tribally significant religious or cultural properties that may be located in or near the project area in order to identify and address tribal concerns. On March 24, 2010, the BLM received a response letter from the Ysleta del Sur Pueblo (Loera 2010). The Pueblo is not opposed to the proposed project and believes the project would not adversely affect traditional, religious, or culturally significant sites of their Pueblo; however, they would like to be consulted if any human remains or artifacts that fall under the NAGPRA are unearthed during the project.

In December 2010, all tribes with a known interest in the area were invited to become cooperating agencies for this EIS.

3.14 Health and Safety; Hazardous Materials

3.14.1 Introduction

The affected environment for hazardous materials, health, and safety includes air, water, soil, and biological resources that potentially could be affected by an accidental release of hazardous materials during storage and use at the mine. The study area for direct and indirect impacts for hazardous materials and solid waste encompasses the proposed project operations boundary.

3.14.1.1 Regulatory Definitions of Hazardous Materials

“Hazardous materials,” which are defined in various ways under a number of regulatory programs, can represent potential risks to both human health and the environment when not properly managed. The term hazardous materials includes the following materials that may be utilized or disposed of in conjunction with mining operations:

- Substances covered under OSHA and Mine Safety and Health Administration (MSHA) Hazard Communication Standards (29 CFR 1910.1200 and 30 CFR 42): The types of materials that may be used in mining activities and that would be subject to these regulations would include almost all of the materials identified above.
- “Hazardous materials” as defined under USDOT regulations at 49 CFR, Parts 170-177: The types of materials that may be used in mining activities and that would be subject to these regulations would include sodium cyanide, explosives, cement, fuels, some paints and coatings, and other chemical products.
- “Hazardous substances” as defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and listed in 40 CFR §302.4, Table 302.4: The types of materials that may contain hazardous substances that are used in mining activities and that would be subject to these requirements would include sodium cyanide, solvents, solvent containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.
- “Hazardous wastes” as defined in the RCRA: Procedures in 40 CFR 262 are used to determine whether a waste is a hazardous waste. The types of materials used in mining activities and that could be subject to these requirements could include liquid waste materials with a flash point of less than 140°F, spent solvent containing wastes, corrosive liquids, and lab assay wastes. Hazardous wastes are regulated under Subtitle C of RCRA.

- Any “hazardous substances” and “extremely hazardous substances” as well as petroleum products such as gasoline, diesel, or propane, that are subject to reporting requirements if volumes on-hand exceed threshold planning quantities under Sections 311 and 312 of Superfund Amendments and Reauthorization Act (SARA): The types of materials that may be used in mining activities and that could be subject to these requirements would include fuels, coolants, acids, and solvent-containing products such as paints and coatings.
- Petroleum products defined as “oil” in the Oil Pollution Act of 1990: The types of materials used in mining activities and that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following provides information regarding management requirements during storage and use of particular hazardous chemicals, substances, or materials:

- The SARA Title III List of Lists or the Consolidated List of Chemicals Subject to Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the CAA.
- Certain types of materials, while they may contain potentially hazardous constituents, are specifically exempt from regulation as hazardous wastes. Used oil, for example, may contain toxic metals, but would not be considered a hazardous waste unless it meets certain criteria. Other wastes that might otherwise be classified as hazardous are managed as “universal wastes” and are exempted from hazardous waste regulation as long as those materials are handled in ways specifically defined by regulation. An example of a material that could be managed as a universal waste is lead-acid batteries. As long as lead-acid batteries are recycled appropriately, requirements for hazardous waste do not apply.
- Pursuant to regulations promulgated under CERCLA, as amended by SARA, release of a reportable quantity of a hazardous substance to the environment must be reported within 24 hours to the National Response Center (40 CFR Part 302). The New Mexico Environment Department also requires immediate reporting of a release of a hazardous substance as soon as possible, but not later than 24 hours after the event, to the New Mexico Environment Department (NMED 2010a). Intrepid has Spill Prevention, Controls, and Countermeasures (SPCC) plans in place to prevent and contain a hazardous material spill (Intrepid Potash, Inc. 2010d). The storage of hazardous materials is regulated by the Hazardous Waste Bureau (NMAC 20.4.1) under the NMED (2010b).

3.14.1.2 Project-related Hazardous Materials

The types of hazardous materials to be used in the proposed mining operations are briefly summarized below:

- Diesel fuel, gasoline, oils, greases, anti-freeze, and solvents used for equipment operation and maintenance
- Butric acid, hydrochloric acid, clay blinder, hexanol, flocculants, lime, and guar
- Wastes classified as hazardous waste

3.14.1.3 Regulatory Definition of Solid Waste

Solid waste consists of a broad range of materials that include garbage, refuse, wastewater treatment plant sludge, non-hazardous industrial waste, and other materials (solid, liquid, or contained gaseous substances) resulting from industrial, commercial, mining, agricultural, and community activities (USEPA 2006). Solid wastes are regulated under different subtitles of RCRA and include hazardous waste (discussed in the previous section) and non-hazardous waste. Non-hazardous wastes are regulated under RCRA Subtitle D. In New Mexico, solid waste rules are found in the NMAC. Disposal of solid waste is regulated under NMAC 20.9.2.0 to 20.9.2.22; disposal of hazardous waste is regulated under NMAC 20.9.8.

3.14.1.4 Solid Wastes Generated from Mining Operations

The solid wastes at the proposed mine would include hazardous waste, solid non-hazardous waste, and sanitary waste. The facility generates hazardous waste in amounts to be considered a Conditionally Exempt Small Quantity Generator under the RCRA waste generator rules (less than 200 pounds per month) (USEPA 2010c). Hazardous waste would consist of "universal wastes," which include florescent bulbs, aerosol paint can residue and filters, and batteries. Solid non-hazardous materials (for example, construction debris and trash) would be disposed at an off-site licensed facility. Appropriate materials (used oil, lead acid batteries, and antifreeze) would be recycled. Sanitary wastes would be dealt with by construction of a new septic system, which would be installed to service the proposed mill. Solid wastes that are expected to be generated include hazardous waste from the aerosol can aspirator and used oil.

3.14.1.5 Health and Safety

Mining operations often have a controlled entrance to the mine site. Additionally, mining operations are usually fenced to limit access and promote onsite security. Mine employees are often required to take multiple forms of safety training and adhere to safety regulations. Public uses for the area include hunting, camping, OHV use, and picnicking. The project area is also utilized by grazing lessees, oil and gas operations, as well as motorists traveling on local roads and state and U.S. highways. Potash mining activities in the past have resulted in areas of subsidence across portions of the project area.

3.15 Socioeconomics and Environmental Justice

3.15.1 Analysis Area

Eddy County and Carlsbad comprise the primary study area for socioeconomic effects of the Proposed Action and alternatives. Eddy County provides most public services to the project area and the majority of the project's construction and expanded operations work forces are likely to live in Carlsbad, based on the distribution of Intrepid's current work force (**Table 3.15-1**).

Table 3.15-1 Residency Distribution of Intrepid's Current Work Force, October 2009

	Carlsbad	Loving	Hobbs	Elsewhere in New Mexico	Out of State
Number of Workers	550	36	22	13	8
Percent of Total	87.4%	5.7%	3.5%	2.1%	1.3%

Source: Intrepid Potash, November 2009.

The Eddy County community of Artesia is over 30 miles from the project area. Less than 1 percent of Intrepid's current work force lives in Artesia and it is unlikely to be substantially affected by construction and operation of the Proposed Action or alternatives.

The Village of Loving has no motels, recreational vehicle (RV) parks, or mobile home parks and is therefore also unlikely to host construction workers or experience substantial socioeconomic impacts from implementation of the HB In-Situ Solution Mine Project.

A small percentage (22 workers) of Intrepid's present work force live in Hobbs (2008 population 30,746), located about 35 miles east of the project area in neighboring Lea County. More than 15 motels and several large RV parks are located in Hobbs, nearby Eunice (2008 population 2,771) and the surrounding area. These accommodations serve tourists, the region's natural resource industry, and the nonlocal construction work force for the Louisiana Energy Service's National Enrichment Facility (NEF) (New Mexico Business Weekly 2008). As construction on the NEF nears completion in late 2010/early 2011, the construction work force will be scaled back from about 700 to 350 to 400 workers. As the scale back occurs, contractors and workers currently working at the NEF may become available and commute to the proposed project. Others may seek permanent jobs at the NEF, which will begin ramping up to about 350 operations workers (Brooks 2010). Because these workers already live in the community, the proposed project would generate few if any incremental socioeconomic impacts in Hobbs.

The potential for effects on other sectors of the local economy (e.g., oil and gas, ranching and grazing, and outdoor recreation) and the linkages to the regional economy are also considered in this assessment.

3.15.2 Socioeconomic Setting

Settlement of southeastern New Mexico by people of European descent began in the late 1800s, following passage of the Homestead Act. Eddy County, formed in 1889, was initially settled by ranchers and later by farmers as irrigation projects were developed. A railroad line linking El Paso, Texas, with Roswell, New Mexico, was constructed in the 1890s, passing through the Town of Eddy, which later became Carlsbad.

In addition to farming and ranching, the county's economic base includes tourism and recreation, initiated by discovery of Carlsbad Caverns, which became a national park in 1930; oil and natural gas, which began with the 1909 discovery of oil near Artesia; and potash, discovered east of Carlsbad in 1925 (Eddy County 2007). Two major federal government employers include WIPP, and the Federal Law Enforcement Training Center (FLETC). WIPP, located about 30 miles east of Carlsbad, began operations as the first transuranic waste storage facility in the nation in 1999. FLETC, located near Artesia, provides law enforcement training for local, state, federal, and international agencies. At any one time, the center trains about 1,000 men and women who are instructed and supported by 300 to 400 staff who live in nearby communities (Eddy County 2008; Carlsbad 2009).

The City of Carlsbad (2008 population 25,629) is located near the center of Eddy County on the Pecos River, about 275 highway miles southeast of Albuquerque. Carlsbad is the governmental and commercial center of Eddy County. The city also hosts service companies for the potash and oil and gas industries and serves as a service center for tourists visiting Carlsbad Caverns National Park and other destinations in the region. Carlsbad also is developing as a retirement community because of climate and area recreation attractions such as golf courses (City of Carlsbad 2009).

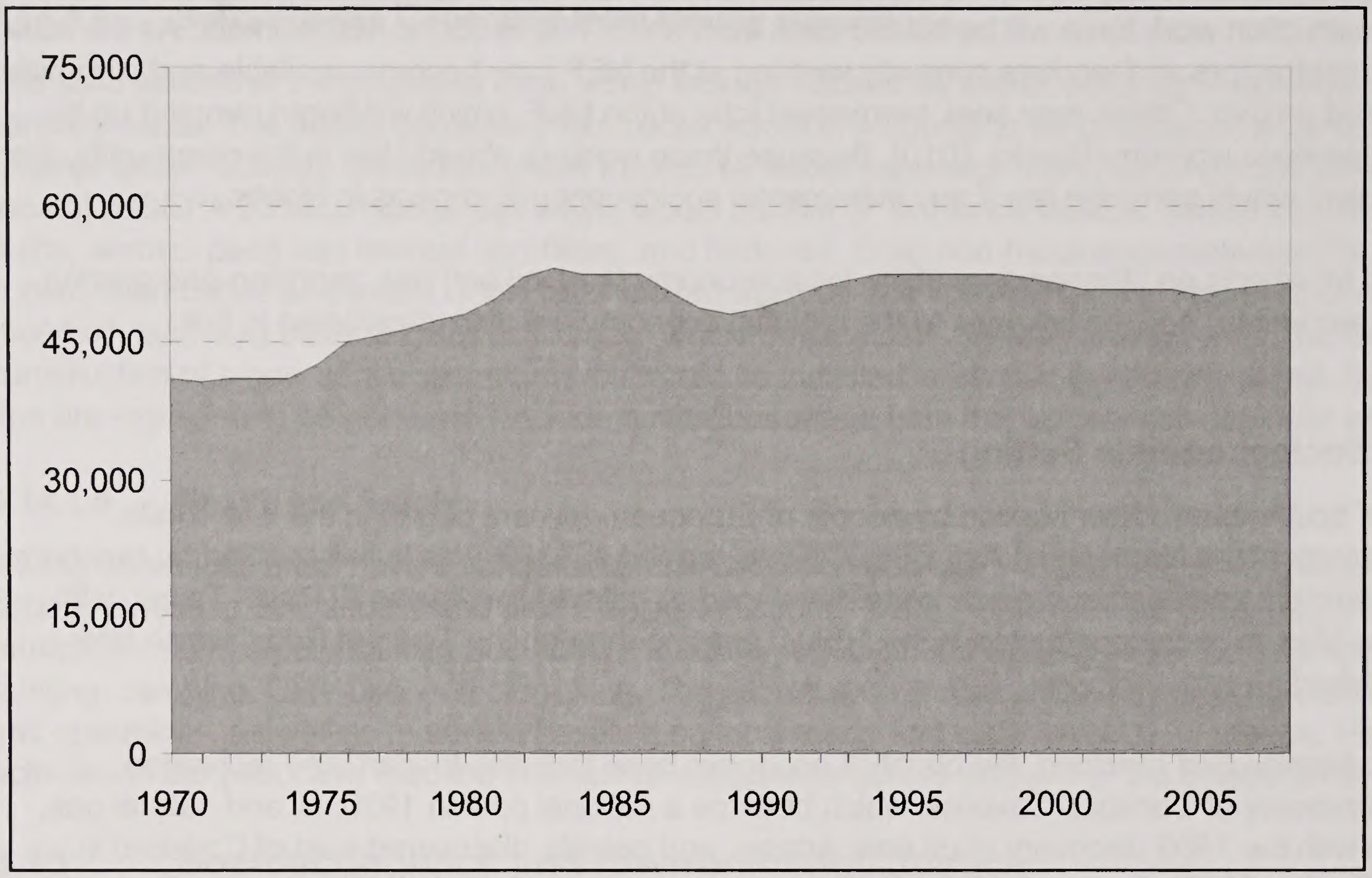
3.15.3 Population and Demographics

Eddy County experienced a near-decade long period of population growth spanning the late 1970s and early 1980s (**Figure 3.15-1**). Oil and gas development was the major driver of this growth as the potash industry had matured and actually experienced declines in production. Resident population peaked at 53,266 in 1983, followed by a brief period of contraction when the county lost about 5,000 residents. Several years of renewed population growth occurred in the early 1990s, but the county's population has since trended slightly downward. Between 2000 and 2008, the U.S. Census Bureau estimates a net loss of 298 residents in Eddy County.

Settlement patterns within Eddy County have remained relatively unchanged in recent years. Approximately half of the population resides in Carlsbad and another 20 percent in Artesia. Approximately 1,300 residents live in Loving, with the remainder in unincorporated areas of the county, as shown in **Table 3.15.2**.

Despite the strong economic gains in recent years, net out-migration from the community has been the dominant trend affecting local population levels. Between 2000 and 2008, net out-migration of nearly

1,900 residents more than offset the net natural increase of approximately 1,600 residents Natural increase, defined as the net difference between the number of births and deaths among residents.



Source: U.S. Bureau of Economic Analysis 2009; U.S. Census Bureau 2009a.

Figure 3.15-1 Eddy County Population, 1970 to 2008

Table 3.15-2 Population Settlement within Eddy County, 2000 to 2008

Area	2000	2004	2008	Change
Eddy County	51,658	50,803	51,360	-298
Carlsbad	25,625	25,309	25,629	4
Artesia	10,692	10,646	10,994	302
Loving	1,326	1,337	1,340	14
Remainder of the County	14,015	13,511	13,397	-618

Source: U.S. Census Bureau 2009a,b.

The median age of Eddy County residents is 37.0 years, with 13.9 percent of all residents aged 65 and over; both values are slightly higher than the comparative statistics for the state. However, Eddy County has a larger share of youthful residents under the age of 18 (**Table 3.15-3**).

Table 3.15-3 Age Distribution and Median Age of the Resident Population 2008

Location	Under 18 (%)	18 to 64 (%)	64 and Over (%)	Median Age
New Mexico	25.5	61.7	12.8	35.8
Eddy County	26.1	60.0	13.9	37.0

Source: U.S. Census Bureau 2009c.

The local population has a higher percentage share of whites and lower percentage shares of minorities and residents who are Hispanic or Latino than does the statewide population (**Table 3.15-4**). The establishment of large ranches, introduction of rail service, the subsequent promotion of the area's climate to outsiders, and discovery of oil and gas, all promoted immigration of whites to the area, the influences of which continue to the present. Another factor contributing to the differences is that there are no Indian reservations in Eddy County, unlike in many parts of New Mexico.

Table 3.15-4 Racial and Ethnic Population Composition, 2000

Location	Percent of the Total Population			
	White and not Hispanic or Latino	American Indian and Alaska Native and not Hispanic or Latino	Other Races, Two or More Races, and not Hispanic or Latino	Hispanic or Latino Ethnicity
New Mexico	41.9	8.7	4.9	44.5
Eddy County	53.7	0.3	3.9	42.1

Source: U.S. Census Bureau 2000.

Long-term population forecasts for Eddy County, released in 2008, anticipated a 2010 population of 54,145, climbing to 60,764 by 2030 (University of New Mexico Bureau of Business and Economic Research [UNM-BBER] 2008). Those projections likely reflect a continuation of pre-recession natural resource development trends. Thus, it would be reasonable to expect that the recent economic downturn could manifest itself in lower growth in the future.

3.15.4 Employment, Labor Force, and Economic Structure

Changes in local labor market conditions over time portray the economic growth that occurred more so than do the changes in population described above. From 2000 to 2009, the local labor force expanded by more than 5,600 workers (24.3 percent) and the number of employed persons climbed by 25 percent. Between 2003 and 2008, the number of unemployed declined by nearly half. Since that time, the global recession, mortgage-lending crisis, and curtailment in local energy development activity contributed to a doubling of unemployment. Unemployment continued to climb through 2009, reaching 6.0 percent by year's end.

The economic growth that occurred in Eddy County for several years preceding the current economic recession was associated with increases in energy resource development, the region's tourism and recreation economy, residential construction, lifestyle migration, and the opening of the FLETC in Artesia. **Table 3.15-5** shows the increases in mining and construction jobs that were two key drivers of the growth. Mining and construction also are key sectors in nearby Lea County economy, with nearly 5,400 mining jobs and 2,340 construction jobs reported in June 2009. Many of the latter are associated with the NEF, which is anticipating reductions in its construction work force in late 2010/early 2011.

Table 3.15-5 Trends in Eddy County Mining and Construction Employment, 2003 to 2009

Industry	2003	2004	2005	2006	2007	2008	2009 (June)
Mining	2,492	2,699	2,821	3,124	3,359	3,752	3,515
Construction	1,162	931	1,064	1,113	1,491	1,921	1,815
Total Covered Employment	19,677	19,743	20,234	21,051	22,030	23,207	23,557

Source: U.S. Bureau of Labor Statistics 2010.

Other key industries in the local economy include retail and wholesale trade, health care, and accommodation and food services. The latter reflects the role of tourism and recreation, much of which is tied to nearby Carlsbad Caverns National Park (400,000+ visitors per year), Guadalupe Mountains National Park (approximately 200,000 visitors per year), and two state parks (NPS 2010; Padilla 2010).

Farm employment accounted for only 3.1 percent of Eddy County employment in 2007; about 40 percent higher than the statewide average. Public sector employment, including public education, stood at 13 percent in 2007, substantially lower than the 18.8 percent of the comparable statewide level (**Table 3.15-6**). The opening and operations of the FLETC, which has expanded over time, now accounts for a substantial segment of all government jobs in the county.

Table 3.15-6 Eddy County Employment, by Major Category, 2007

Geographic Area	Farm	Non-farm Private	Government	Total	Farm	Non-farm Private	Government
New Mexico	24,508	881,017	210,152	1,115,677	2.2	79.0	18.8
Eddy County	911	24,754	3,828	29,493	3.1	83.9	13.0

Source: U.S. Bureau of Economic Analysis 2009.

Despite the high number of mining jobs, the area's agriculture, tourism, and federal government sectors provide Eddy County's economy a greater degree of economic diversity than rural economies that are heavily dependent on a single major industry. This diversity diminishes the regional economy's susceptibility to severe economic distress and enhances its economic resilience.

Natural resource development, ushered in by the discovery of oil in 1909 and discovery of potash in 1925, has long been a mainstay of the area economy. Such development provides jobs, and capital investment, spending, and production generates tax revenues to support state and local government and public education (Eddy County 2007). Indicators of the industry's importance include the following:

- In 2007, the local mining industry reported total employee earnings of $383 million, equivalent to 21 percent of the total personal income in Eddy County in that year.
- During the second quarter of 2009, 116 mining establishments were reported in Eddy County by the New Mexico Department of Labor: 38 active in oil and gas extraction, 8 in conventional mining, and 70 in support activities for mining. Each of the three segments had about 1,150 employees.
- For tax year 2008, the net taxable value on oil and gas and mineral production in Eddy County topped $1.4 billion, with another $286 million in net taxable value on oil and gas equipment.
- The $1.7 billion in taxable value on oil and gas and mineral production ranked Eddy County 3rd among New Mexico counties in terms of resource-related valuation; neighboring Lea County (oil and gas) was first, followed by San Juan County (coal and gas) (New Mexico Taxation & Revenue Department 2009).
- In 2007, local potash production had a market value of approximately $270 million. The market value of oil and gas production was not reported, but likely several times greater based on the reported production of 21.1 million barrels of oil and 262.5 million MCF (MCF = 1,000 cubic feet of gas) of gas.

The area of commercially viable potash is surrounded by existing oil and gas development and overlies commercially recoverable carbon-based reserves. The overlap of resources and management of the area under the 1986 Secretary's Potash Order has contributed to tensions between the two industries.

3.15.5 Farming and Ranching

The local agriculture industry is another element of the area's economic base. Data from the 2007 Census of Agriculture provides the following characteristics regarding farming and ranching in the area (USDA 2009).

- There were 543 farms and ranches in Eddy County, with a total associated land area of 1.11 million acres.
- In 2007 the farms and ranches produced $94.8 million in crop and livestock sales. The top commodities, in terms of market value, were milk and dairy products, hay and other forage, and cattle and calves.
- Dairy operations comprise an important element of the local agriculture sector with 12 dairy farms reporting a total of 12,742 dairy cattle in 2007. Those numbers compare to 175 non-dairy farms and ranches reporting a total of 17,781 beef cattle.
- About 46 percent of all farms and ranches were operated by individuals reporting agriculture as their primary occupation.
- About 43 percent of all farms and ranches reported no sales or less than $5,000 in sales of livestock or farm products in 2007, 24 percent having annual sales of $50,000 or more.
- Many farmers and ranchers in the area utilize grazing on public lands. Grazing on public lands allows ranchers to use available private irrigated lands to grow hay for use as winter feed or for sale as a cash crop. Approximately 4,500 AUMs of grazing occur within the project area.

3.15.6 Personal Income and Poverty

Personal income is an important measure of economic well-being for communities and individuals. Total annual personal income trends in the study area reflect the key economic and demographic conditions described above.

For the period of 2000 to 2007, Eddy County registered a 66 percent increase in total personal income, from $1.06 billion to $1.76 billion, 16 percentage points higher than the 50 percent growth registered statewide (USBEA 2009). General inflationary trends account for about 20 percent of the changes, but the majority of the increases reflect economic growth and rising income. The residual translates into real per capita income growth. In 2007, Eddy County accounted for nearly 3 percent of statewide personal income.

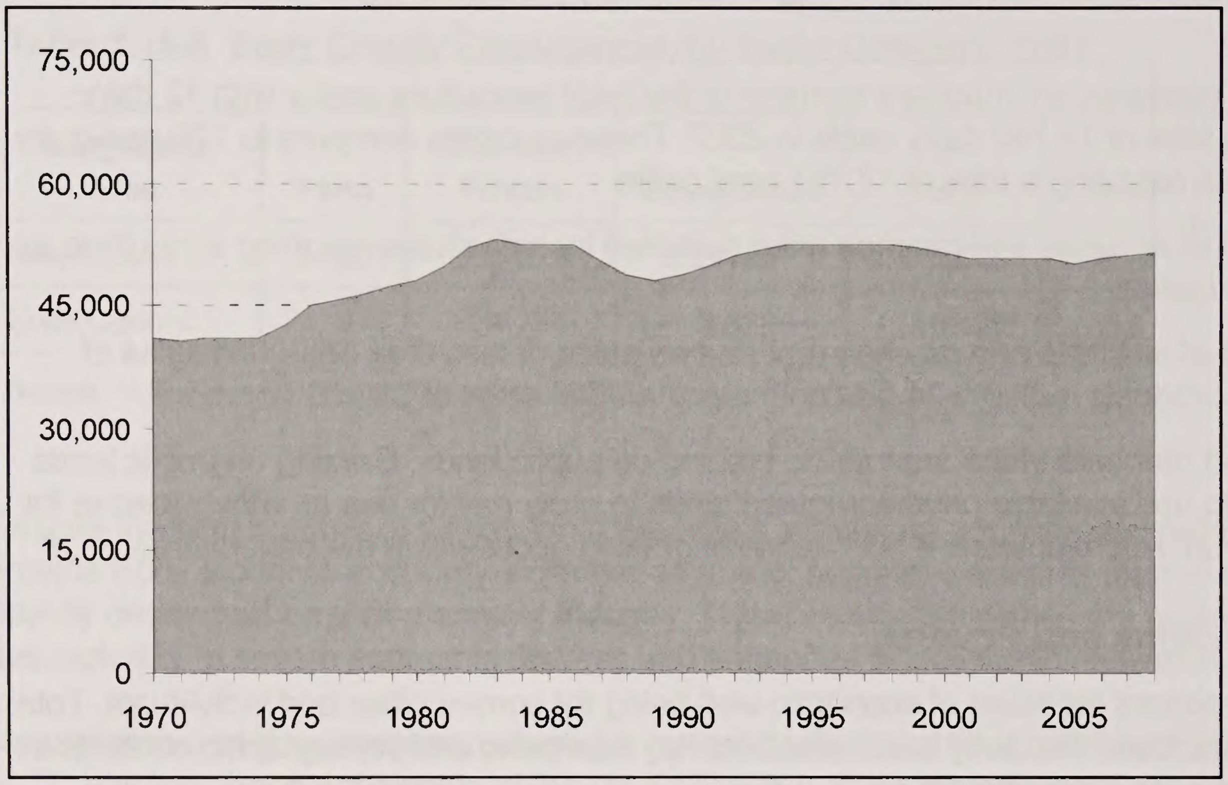
For many years, per capita income in Eddy County lagged the statewide average, both of which lag behind the national average. In recent years, local personal income growth in Eddy County outpaced that across the state such that per capita personal income in 2007 was nearly $4,000 per person higher in Eddy County, compared to the statewide average ($34,523 versus $30,706). Despite the growth in local income, per capita income in Eddy County continued to lag behind the national average, as shown in **Figure 3.15-2**. After adjusting for inflation, real per capita personal income increased by 40 percent in Eddy County from 2000 to 2007, compared to 16 percent across the state and 8 percent across the nation.

The trends in total and per capita personal income in Eddy County manifest themselves in modest reductions in the local incidence of poverty and higher median household incomes. In 2008, an estimated 15.3 percent of all residents of Eddy County had incomes below the established poverty level, with approximately 600 fewer residents in poverty, compared to 2004. The strong local income growth raised the median household income Eddy County above the statewide median (U.S. Census Bureau 2009d).

3.15.7 Housing

3.15.7.1 Eddy County

Eddy County housing stock has changed little since in recent years. The 2000 census reported just over 70 percent of all housing was single family. The U.S. Census Bureau reports 259 new units or just over 1 percent of total housing units between 2000 and by 2008. However, building permits for more than 700 new units were issued during that same period, suggesting much of the construction was for replacement demand. Virtually all of the permits were for new single family units (U.S. Census Bureau 2009e).



Source: USBEA 2009.

Figure 3.15-2 Trends in Per Capita Income, 2000 to 2007

Affordable work force housing is an issue for municipalities in Eddy County, resulting in some workers not being able to find affordable housing in the communities where they work (Eddy County 2008).

3.15.7.2 Carlsbad

The City of Carlsbad completed a Housing Analysis and Strategic Plan for the Greater Carlsbad Area (housing analysis) (Carlsbad 2009). Key findings of the housing analysis were that:

- Carlsbad is experiencing a housing shortage that affects the community's quality of life and hinders the expansion potential of the local economy.
- Young, working families and retirees comprise the primary market for housing. The greatest need is for multi-family rentals, particularly multi-bedroom units. A need also exists for single-family detached homes.
- Rehabilitation or replacement of older and poorly maintained housing is another identified need.
- There is an unmet demand for low-income and affordable housing.
- Constraints and impediments to the development of new housing in Carlsbad include the absence of utility (water, wastewater, and storm drainage) infrastructure in certain areas, and difficulty in obtaining financing in the current (early 2010) market. Nevertheless, some active residential subdivision activity is occurring in the community.

The housing analysis identified 12,501 housing units within the Greater Carlsbad area (the city and the planning area within a 5-mile radius of the city limits), of which 11,452 units were located within the city limits. Of the Greater Carlsbad total, 10.3 percent (1,398 units) were mobile homes and trailers and about 9 percent (1,082) units were in multi-family complexes of 3 to 50 or more units.

According to the housing analysis, the overall housing vacancy rate stood at over 12 percent. However, only 2 percent were vacant for rent and 6 percent were vacant for sale at the time of the census. The housing analysis indicated that a survey of apartment managers revealed a vacancy rate approaching zero; and all had waiting lists.

The housing analysis reported 120 housing units for sale during late 2008, representing less than 2 percent of the total housing stock. The housing market remains tight, as demonstrated by information from the National Association of Realtors indicating only 168 units listed for sale in Carlsbad, 32 of which are listed at or over $300,000 (National Association of Realtors 2009).

Regarding future housing needs, the housing analysis identified an existing need for up to 50 market-rate temporary housing units and future needs for 50 additional such units per year. Up to 240 market-rate ownership units are needed. In addition, need for approximately 1,600 units for low-income and cost burdened households was identified. The housing analysis also identified needs for transitional housing, rehabilitation of units currently in poor condition, and expanded supply of units for retirees.

Currently, there is substantial subdivided land within the city being developed on a lot by lot basis. Two single-family home subdivisions have been approved, one with about 200 units and the other with about 85 units. Some new home construction occurred in these subdivisions in recent years.

Two other subdivisions have received zoning approval; one zoned for about 200 apartment units and 100 single family homes, the other zoned for about 185 apartments. The subdivisions are intended to support market rate sales and rentals. At the time of this assessment (first quarter 2010) the developers of these subdivisions were still seeking development financing (Shumsky 2010).

Carlsbad has 10 major motels and 4 major RV parks. During the last surge in oil and gas development, these motels were used heavily by oil and gas field workers, which sometimes resulted in a lack of availability for tourism and recreation visitors (Burgess 2010).

3.15.8 Public Infrastructure, Services, and Local Government Fiscal Conditions

Public infrastructure and services within the socioeconomic study area are provided by Eddy County, the City of Carlsbad, and by a number of special districts and volunteer agencies.

3.15.8.1 Water

There are 30 public water systems within Eddy County. The City of Carlsbad's water system serves the community likely to host most of the work force associated with the proposed HB In-Situ Solution Mine Project. A wellfield located 7 miles southwest of the city is the primary source of the city's water supply. The remainder is provided by the Double Eagle well system located in northwestern Lea County, which draws water from the Ogallala aquifer. Carlsbad is currently implementing a $45.3 million capital improvement program for its water and wastewater systems (City of Carlsbad Undated).

3.15.8.2 Wastewater

The Carlsbad Sewage Collection System is operated by the Carlsbad Water Department. The system includes gravity-fed collection mains and 12 lift stations, all of which feed a single wastewater treatment plant. The plant treats an average of more than 2.5 million gallons of sewage per day, and is designed to treat up to 6 million gpd (City of Carlsbad 2003).

3.15.8.3 Solid Waste Disposal

Eddy County operates the Sandpoint Landfill, located approximately 12 miles east of Carlsbad on Highway 62/180. The City of Carlsbad provides solid waste collection services (Eddy County 2008; City of Carlsbad 2003).

3.15.8.4 Law Enforcement

There are 10 local law enforcement agencies operating in Eddy County. The Eddy County Sheriff's Department provides law enforcement services to the project area and along access routes to the area and also operates a dispatch center for the rural parts of the county. Eddy County also operates a detention center for adults and juveniles. Carlsbad maintains a municipal police department and has its own dispatch center (Eddy County 2008).

3.15.8.5 Emergency Response (Fire and Ambulance)

There are 12 volunteer fire departments (VFDs) in Eddy County. The La Huerta VFD serves the project area. Carlsbad maintains a staffed fire department that serves the city, but which also responds to structure fires near and within the project area and will respond to rangeland fires in that area if no volunteer agency responds. Emergency Medical Technicians from the Carlsbad Fire Department respond to injury accidents and health care emergencies within and near the project area, with back-up from the VFDs when available (Arnwine 2010; Burgess 2010)

3.15.8.6 Health Care

The Carlsbad Medical Center is the acute care hospital serving the community and surrounding region, both for routine health care and for emergency care. The Carlsbad Family Health Center and the Surgical Center of Carlsbad also provide routine health care services for residents of the community. Eddy County provides a variety of public health care and indigent health services.

3.15.8.7 Public Education

The Carlsbad Municipal School District operates 11 primary schools, 2 middle schools, and 1 high school. There is one private elementary school in Carlsbad. Fall enrollment for the 2009-2010 school year is 5,837 students (Eddy County 2008; New Mexico Public Education Department 2010).

3.15.9 Mining as it Relates to Public Sector Fiscal Conditions

Public sector fiscal conditions in the region are integrally linked to natural resource development and presence of public lands in the study area. State and many local entities derive substantial revenues from development activity. The major revenue sources include payments in lieu of taxes on federal lands, gross receipts taxes (GRTs) on the taxable value of commodities sold,(as well as on purchases by energy firms, their vendors and employees), mineral royalties and severance taxes, and ad valorem taxes on the value of production and mining equipment. Recent receipts from several of these sources are highlighted below in order to demonstrate their significance.

Payments in lieu of taxes (PILTs): PILTs are transfers from the federal government to counties with PILT-eligible property within their boundaries to help defray the costs of providing emergency services on those lands and offset some of the property tax revenue foregone due to the public ownership of lands and minerals. PILTs totaling $3.1 million were made to Eddy County in fiscal year 2009 (U.S. Mineral Management Service 2009).

Federal mineral royalties: federal mineral royalties are collected on mineral and oil and gas production from federal lands. Approximately one-half of the receipts are returned to the state in which the production occurred. The funds received by the state accrue primarily to the general fund, with subsequent disbursements to public education and other programs. In fiscal year 2009, federal mineral royalties, rents, and bonus bids on new leases totaled $765.1 million in New Mexico. The majority of the total was derived on the value of natural gas and oil produced. Approximately $388 million was disbursed to the state during the same period.

Oil and gas taxes: New Mexico imposes a severance tax, conservation tax, and an emergency school tax on sales value of oil and gas produced, regardless of ownership. The current combined tax rate is 7.09 percent. The total proceeds from oil and gas taxes are typically more than double the receipts from federal mineral royalties (New Mexico Energy, Minerals and Natural Resources Department 2009).

Gross receipts taxes: similar in some respects to a sales tax, the New Mexico GRT is levied on the sales and leases of most goods, property, and services. The rate varies between 5.375 percent and 8.6875 percent across the state, as counties and municipalities have the option to levy GRT as well. The rate in Eddy County ranges from 5.625 percent in unincorporated areas of the county to 7.3125 percent in Carlsbad (New Mexico Taxation and Revenue Department 2009). As shown in **Table 3.15-7**, GRTs levied on mining and oil and gas extraction generated $20.5 million in Eddy County in 2009. That total represents 14.6 percent of all GRTs in Eddy County, and also more than 17 percent of the statewide total of $118.3 million from mining and oil and gas extraction.

Table 3.15-7 Direct Contributions of Mining and Oil and Gas to Eddy County and Statewide Gross Receipts Taxes, 2009

	State of New Mexico			Eddy County		
	(millions)					
Industry	Gross Receipts	Taxable Gross	Gross Tax	Gross Receipts	Taxable Gross	Gross Tax
Mining and Oil and Gas Extraction Industries	$3,522.1	$1,899.9	$118.3	$772.4	$333.6	$20.5
Total – All industries	$95,490.4	$45,876.1	$3,086.1	$3,475.7	$2,150.5	$140.4
Mining and Oil and Gas % of Total	3.7	4.1	3.8	22.2	15.5	14.6

Source: New Mexico Taxation and Revenue Department 2009.

The contributions of mining and oil and gas extraction would be even greater if the indirect and induced effects associated with exploration, development, and production were included.

Eddy County and other local taxing authorities assess and collect ad valorem property taxes on mineral production and mining related equipment located within its taxing boundaries. For the 2008 tax year, the aggregate net taxable value assessed on such production and equipment in Eddy County exceeded $1.69 billion, approximately two-thirds of the county's total net taxable value. Eddy County collected more than $20.7 million in ad valorem/property taxes that same year. Taxable values are a function of both production and commodity prices and therefore subject to substantial year-to-year fluctuation (New Mexico Department of Finance and Administration 2009; New Mexico Taxation and Revenue Department 2009).

Public service demands associated with such activity also factor into public sector expenditures. However, because of the limited scale of the incremental demands associated with the proposed HB In-Situ Solution Mine Project, a full analysis of public sector conditions is outside the scope of this assessment.

3.15.10 Social Organization and Conditions

This section focuses on social conditions within Eddy County and within and near the project area. Information for this section was obtained from public scoping comments, newspaper articles, interviews with local officials and staff, and secondary sources as cited.

Residents of Eddy County are familiar with potash mining, other forms of natural resource development, and major construction projects. Many in Eddy County and Carlsbad welcome the economic boost associated with construction projects and resource development. Some enthusiasm toward natural resource development was tempered by the recent collapse of a brine well on the outskirts of Carlsbad. The collapse, along with collapses of two other brine wells in Eddy County heightened concern about subsidence associated with the injection of water into salt formations. Such concern was amplified by media coverage surrounding the collapse and efforts by the city, county, state, and an interagency and industry working group to address the issue.

Ranching, outdoor recreation, oil and gas production, and potash mining have coexisted as elements of the Eddy County social and economic fabric for over 80 years. Each of these activities is a vital element of the Eddy County economy and each provides a measure of economic diversity for the county. The potential for conflict arises when two or more of these economic activities occupy the same space, are in close proximity to each other, or have the potential to limit access to resources for development. In the case of the proposed project area, ranching, outdoor recreation, oil and gas production, and potash mining activities are all present within and near the project area.

3.15.10.1 Ranching and Grazing

Portions of five grazing allotments are contained within the project area. Ranching and grazing operator's concerns include the effects of aboveground pipelines on livestock and movement, the effects of subsidence on rangeland, range improvements and surface water resources, the effect of groundwater pumping and injection on surface water resources, reductions in forage associated with pipeline and power line ROWs, and the potential effects of construction activities and mine operations on the production of the forage adjacent to these activities.

3.15.10.2 Outdoor Recreation

The primary outdoor recreation activity occurring in and near the project area is OHV use, although some hunting and other dispersed recreation also occurs. Approximately one-fifth of the 55,000-acre Hackberry Lake OHV Area, managed by the BLM for intensive use of motorcycles, sand dune buggies, and other OHVs, lies within the project area. Camping occurs in association with these activities although there are no developed campground facilities and no developed source of drinking water in the area. There are private lands within the Hackberry Lake OHV Area where grazing, mining, oil and gas development, and communication and utility rights-of-way also are present. Although outdoor recreation users are accustomed to sharing the project area with other uses, a key concern is the potential for aboveground pipelines to alter the character of the OHV area landscape and pose a hazard for OHV users.

3.15.10.3 Oil and Gas

There are 23 producing oil wells, 29 producing gas wells, 1 water injection well, and 3 disposal wells in the project area, as well as 52 plugged and abandoned oil wells and 8 plugged and abandoned gas wells. A total of 60 unsuccessful wells (dry holes) have been drilled in the area. There also are gathering systems and other ancillary facilities such as tank batteries. Oil and gas exploration continues within the project area. At a basic level, the concerns of the oil and gas industry include the potential effects of the proposed mining project on existing oil and gas facilities and operations and the potential that the proposed project may constrain future oil and gas development within the project area. While oil and gas operators holding leases in the project area have some specific concerns related to proposed project, these concerns are set against tension between the oil and gas industry and potash mining interests dating back to the time when the two industries began operating in the area. In reality, however, there would be no change in how oil and gas leasing and development would be managed as a result of the proposed solution mining project.

3.15.10.4 Potash Mining

Four inactive mine workings are located within the project area. The concerns of the potash industry essentially mirror those of the oil and gas industry, seeking to ensure that existing and future oil and gas development does not limit the potash industries' ability to develop the potash resource. The tension between these two industries arises from competing economic interests for collocated resources and from concerns regarding potential safety and liability associated with concurrent development by both industries.

3.15.11 Environmental Justice

Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 1998). EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, tasks "each Federal agency [to] make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high adverse human health and environmental effects of its programs, policies, and activities on minority populations and low-income populations."

Implementation of EO 12898 for NEPA requires the following steps:

- Identification of the presence of minority and low-income populations and Indian Tribes in areas that may be affected by the action under consideration.
- Determination of whether the action under consideration would have human health, environmental, or other effects on any population.
- Determination of whether such environmental, human health, or other effects would be disproportionately high and adverse on minority or low-income populations or Indian Tribes.
- Provision of opportunities for effective community participation in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of public meetings, crucial documents, and notices (CEQ 1998).

The portion of Eddy County surrounding the project area has a very low population density. The closest Census Block, the basic unit of geography used to enumerate population in the decennial census, with more than 10 persons is at least 8 miles from the project area. There is a ranch within the project boundary and a residence approximately 2 miles to the south of the project boundary on Highway 31. Census Block Group 1 (CBG 1) of Census Tract 9, which surrounds the project area, covers 1,567 square miles and had a total population of 2,725 persons (or 1.7 persons per square mile) in 2000. Most of the population in CBG 1 is contained in areas surrounding the communities of Artesia, Riverside, and Loco Hills. The population density outside of these population centers averages less than 1 person per 3 square miles.

The City of Carlsbad is located about 20 miles west of the project area. The city's distance from the project area, its racial and ethnic composition, existence of substantial levels of intervening oil and gas development, lack of identified concerns during scoping, limited scale of incremental impacts, established operations of the mine, and effective land use buffer created by the Secretary's order, effectively dismiss Environmental Justice as an issue in the City of Carlsbad.

Table 3.15-8 presents 2000 Census information on the prevalence of minority populations in Eddy County, Carlsbad and the rural area surrounding the project area. As shown, the concentration of minority populations in each of these geographies is substantially lower than the New Mexico statewide average.

Table 3.15-8 Percentage of Minorities in Geographic Comparison Areas

Geographic Area	Percentage of Total Population				Variation in the Percentage of Minority Population to the Statewide Average
	White Alone and Non-Hispanic	Hispanic or Latino	Other Racial and Ethnic Minorities	Total Racial and Ethnic Minorities	
United States	69.1	12.5	18.3	30.9	n/a
New Mexico	44.7	42.1	13.2	55.3	n/a
Eddy County	57.7	38.8	3.6	42.3	-13.0
Census Tract 9	63.1	34.6	2.3	36.9	-18.4
Block Group 1, Census Tract 9	63.0	34.1	2.9	37.0	-18.3
Carlsbad	58.8	36.7	4.4	41.2	-14.1

Note: Racial minorities includes all persons identifying themselves in the census as a non-white race, including "Black or African American," "American Indian and Alaska Native," "Asian," "Native Hawaiian and Other Pacific Islander," "Some other race alone," and "Two or more races." Ethnic minorities include persons who identify themselves as Hispanic or Latino. Hispanic or Latino persons can identify themselves as part of any race.

Source: U.S. Census Bureau 2002a.

Table 3.15-9 identifies the prevalence of low-income populations in Eddy County, Carlsbad, and the rural area surrounding the project area. As with minority populations, the concentration of low-income populations in each of these geographies is lower than the New Mexico statewide average. In some cases the population below 150 percent of the poverty level is slightly, but not meaningfully, higher than the statewide average.

Based on the absence of human habitation within the project area, the very low population densities in areas surrounding the project area, and the comparatively low prevalence of minority and low-income populations in the area surrounding the project, the City of Carlsbad, and Eddy County in general, no Environmental Justice populations have been identified for this assessment.

Table 3.15-9 Percentage of Low-Income Population in Geographic Comparison Areas

Geographic Area	Percentage of Total Population Below 100% of Poverty Level	Percentage of Total Population Below 150% of Poverty Level	Percentage of Low-income Population Above/Below Statewide Average
United States	2.4	20.9	n/a
New Mexico	18.4	30.6	n/a
Eddy County	17.2	31.1	-1.2
Census Tract 9	17.2	33.1	-1.2
Block Group 1, Census Tract 9	13.9	26.5	-4.6
Carlsbad	16.5	30.5	-2.0

Source: U.S. Census Bureau 2002b.

4.0 Environmental Effects

4.1 Introduction

This chapter presents the analysis of impacts for each resource that would be affected by the proposed project. Each section provides an overview of the issues identified during public scoping as well as during discussions with BLM staff and interviews with industry and local community representatives. Each section summarizes the method of analysis including the type of information used and the assumptions made during the impact analysis, then describes the projected analysis of impacts for each alternative in as much detail as possible. Resources were evaluated according to the available data, so some discussions are based on qualitative information and some on more detailed quantitative data that was prepared for the project or acquired from other sources.

Impact analysis assumes that the applicant-committed environmental protection measures and those required by the BLM would be successfully implemented. It is also assumed that the proponent, Intrepid Potash, would comply with state and federal regulations that are applicable to the project. Each section identifies key points on which the determination of the significance of impacts is based, recommends mitigation measures where appropriate to minimize potentially significant or important impacts, then provides a brief comparison of impacts under each alternative. Residual impacts are those that would remain after environmental protection measures, recommended mitigation measures, and compliance with laws and regulations are completed if impacts cannot be fully avoided or mitigated.

No impacts from the proposed solution mining project have been identified that would affect operations or land at WIPP, so it will not be discussed further in this chapter.

4.2 Geology and Minerals

4.2.1 Issues

4.2.1.1 Subsidence-related Hazards

Subsidence issues are prevalent in southeastern New Mexico. Subsidence can result from natural conditions found in the Delaware Basin or mineral extraction activities and potentially can affect surface resources, structures, and utilities associated with the project. Removal of subsurface material creates underground voids. Voids may cause subsidence and associated effects. Another major concern is the presence of plugged and currently operating oil and gas wellbores that penetrate the proposed potash solution mining zone. Wells that have poor casing and cement integrity are potential conduits for unsaturated fluids. Through wellbores, unsaturated fluid can reach potash mining flood pools on the surface and potash mining solutions can reach oil and gas producing zones below. Unrestricted migration of unsaturated fluids can also cause dissolution of evaporate zones and create voids.

4.2.1.2 Other Geological Hazards

Potential hazards from seismicity are of lesser concern due to the low probability of adverse effects to the project. Landslides are not considered further because of low potential for these hazards to impact the project.

The primary concerns from project implementation related to the impacts on caves and karst features include the following:

- Dewatering of the near-surface karst aquifers may cause a loss of habitat for cave-adapted species.
- New surface facilities may leak or rupture due to ground shifting caused by the collapse of karst features.
- Brine water from leaking or ruptured pipelines may enter the groundwater system through surface karst features.

4.2.1.3 Mineral Resources

There are several issues related to mineral resources that were raised primarily by the oil and gas industry related to the historical conflicts between mining and oil and natural gas production. Addressed in this section are concerns that the proposed project may result in:

- Restricted access to oil and gas resources.
- Damage to existing oil and gas wells and surface facilities resulting in lost or delayed recovery of the resource.
- Increased fluid mineral recovery costs due to drilling and well construction problems such as lost circulation or highly corrosive fluids.

4.2.1.4 Paleontological Resources

Impacts to paleontological resources potentially could occur from the loss and destruction of scientifically important fossils.

4.2.2 Method of Analysis

4.2.2.1 Geological Hazards

Subsidence

In the analysis of impacts of subsidence, the following information was reviewed to determine the effect that natural and human-caused subsidence would have on the proposed facilities and land in the project area. The analysis and findings detailed in the technical support document "Regional Geology; Geology and Minerals Issues Related to the Proposed HB In-Situ Solution Mine Project" (AECOM 2010a) are incorporated by reference.

- Publicly available reports on local evaporite karst conditions including, but not limited to Bachman (1985); Hill (1996); Lambert (1983); Powers and Owsley (2003b); and Vine (1963, 1960).
- Documentation on sinkholes in the vicinity of the project area.
- Publicly available information on the effects of subsidence on surface infrastructure (Galloway 2008; Johnson 2005).
- Reported and predicted subsidence from historical potash mining (Golder and Associates 1979).
- Predictions of expected subsidence from solution potash mining (Intrepid Potash, Inc./Shaw 2008a,b,c).
- Basic principles of subsidence resulting from the mining of tabular ore bodies (British National Coal Board 1975).
- Thickness and depth of the previously mined ore zone that is the target of proposed solution mining.

Oil and Gas Activities

The analysis of potential impacts on the proposed project from oil and gas activities was determined based on information available regarding well drilling and completion practices in the proposed flood zones. The information available includes:

- The OCD database (OCD 2009a) provided well drilling histories, completion reports, sundry notices, plugging reports, relevant correspondence, and environmental files.
- Academic journals that document the historic drilling and completion practices in the project area (Cearly 2000; Johnson et al. 2003a; Powers 2003a,b; Wills 1942).

The data and information sources were reviewed for information on well completions, cementing, operational integrity, produced water disposal, and plugging integrity. This information was analyzed to assess the potential risk that the well bores may act as migration pathways for fluids.

Other Geological Hazards

The following types of information were reviewed to determine the nature and potential severity of seismicity in the project area and southeastern New Mexico.

- Quaternary Fold and Fault Database (USGS and NMBGMR 2006).
- National Earthquake Information Center (USGS 2010).
- USGS National Seismic Hazard maps (Peterson et al. 2008).
- National Atlas (2009).

4.2.2.2 Caves

The following types of information were reviewed to gain an understanding of cave formation and potential hazards posed by caves as well the risks to caves from proposed project activities:

- BLM documentation of the location of caves and their value.
- Discussion with BLM personnel knowledgeable of caves in the area.
- Published literature on caves and karst in the Delaware Basin including Hill (1996, 1987); Lambert (1983); Southwest Region National Speleological Society (1991); Stafford (2008); Vine (1963).

4.2.2.3 Mineral Resources

The following documents and sources were reviewed pursuant to impact analysis to mineral resources:

- Information available online in the OCD database (OCD 2009a).
- Publicly available publications concerning history of oil and gas development and resource assessment in the Delaware Basin in general and the SPA in particular including Broadhead et al. (2004); Montgomery (1965); Schenk et al. (2008); and Walsh (2006).
- Publicly available information on potash mining in the Delaware Basin including mining history, mining methods, production, and remaining reserves including Barker et al. (2008); Cheeseman (1978); Kern (1984); USGS (2009a).
- Government agency documents including the Secretary's Potash Order (1986 Order) and Order R-111-P (OCC 1988).
- IM NM-2011-03: Interim Processing Guidelines, Oil and Gas applications for permit to drill (APDs) within the Secretary's Designated Potash Area, Carlsbad Field Office.

- Mine Operations and Closure Plan HB In-situ Project (Intrepid Potash, Inc./Shaw 2008a).
- BLM estimates of future oil and gas drilling in the SPA (Alderman 2010).

The information and data described above was reviewed to determine what impact the proposed project activities would have on the recovery of additional potash resources and impacts to the accessibility to oil and gas resources.

4.2.2.4 Paleontological Resources

The following sources of information were reviewed in the analysis of potential impacts to paleontological resources:

- BLM statutes and guidance regarding regulation of fossil resources on public lands (2010, 2007a).
- Published information sources on paleontological resources in the project area and the Delaware Basin including, but not limited to, Harris (1993); Hill (1987); King (1948); Lehman and Chatterjee (2005); Vine (1963); Walter (1953).

The PFYC of each formation was used to develop an assessment of risk to potential fossil resources with regard to ground-disturbing activities from the proposed project.

4.2.3 Assumptions

Assumptions used in the analysis of subsidence impacts:

- The natural process of evaporite dissolution is ongoing and will continue for the foreseeable future.
- Naturally induced subsidence may pose risks equal to anthropogenic-induced subsidence and the potential for the manifestation of subsidence may not be predictable.
- The potash mining industry in the region has experience with the extraction of tabular ore bodies that result in predictable subsidence effects based on well-established parameters.
- There are no major faults or discontinuities in the project area that would cause the typical subsidence patterns to be altered.
- Adverse impacts from natural subsidence would occur if the hazard presents an imminent risk to public safety.
- Direct effects include subsidence that damages roads, utilities, and structures. Impacts from direct effects range from very slight (extension cracks) to severe (sinkholes).
- Indirect effects include the alteration of surface drainage, disruption of shallow water tables, and public safety hazards.

Assumptions used in the analysis of potential impacts from oil and gas activities:

- Information available in the OCD online database is substantially complete.
- Oil and gas wells drilled and operated prior to 1955 and within mined out areas (not just the proposed flood zones) are the main focus of this analysis.
- Wells plugged under the supervision of the potash mining company may not have guaranteed the safety and integrity of the plugging.
- Improper plugging could result in catastrophic subsidence similar to the Wink and Jal sinkholes (described in Section 3.2).

Assumptions used in the analysis of potential impacts to caves and karst include the following:

- Underground voids (karst features) derived from natural processes may be present, but have yet to be manifested on the surface, posing hazards to activities and facilities on the surface through collapse.
- Some caves in the area have been nominated as Significant Caves under the Federal Cave Resources Protection Act of 1988 based on several resource values. It is assumed that there are other caves yet to be discovered that have the potential to be nominated and listed.
- Impacts to cave resources would be considered significant if caves were disturbed to the point where there is a loss of unique cave resources or values.

Assumptions used for other geological hazards

- Based on the lack of seismic activity and the absence of active faults in the project area, the risk of impacts due to ground motion and permanent ground deformation are expected to be very low under all alternatives and will not be discussed further in this analysis.

Assumptions used in the analysis of potential impacts to mineral resources include the following:

- Existing mineral resource recovery estimates are reasonable.
- Conditions of approval and requirements set forth by the 1986 Order and Order R-111-P would be substantially unchanged over the lifetime of the proposed project.
- Impacts to mineral resources would be considered significant if there were a permanent or irretrievable loss of the ability to access and recover a commercial mineral resource.

Assumptions used in the analysis of impacts to paleontological resources include:

- The fossil potential designations for the various formations were based on criteria presented in the PFYC and available data.
- Impacts would be considered significant if proposed activities resulted in the loss of scientifically important fossils.
- Direct impacts would include the destruction or degradation of fossils.
- Indirect impacts involve the restriction of permitted paleontologists access to potential localities unless a discovery is made due to ground-disturbing activities.

4.2.4 No Action Alternative

If the proposed project is not implemented, a number of potential impacts would still present risks to resources in the project area. Those potential risks and impacts are discussed below.

4.2.4.1 Geologic Hazards

Subsidence would continue to pose risks to surface resources. The natural processes that resulted in evaporite karst features in the area would continue to pose risks to roads, structures, and surface topography. The residual subsidence effects of historical mining may continue indefinitely. Because most subsidence from historical mining has probably already occurred (Golder and Associates 1979; Intrepid Potash, Inc./Shaw 2008a,b,c), the effects are expected to be minor. Oil and gas development would continue but the potential adverse impacts from poor well casing integrity and inadequately plugged and abandoned wells would not affect active potash mining.

4.2.4.2 Caves

Caves and cave resources would not be affected under the No Action Alternative. However, caves may be subject to potential degradation by entry of unpermitted cave explorers. Degradation of caves and cave resources by unauthorized exploration are expected to be minor with BLM maintenance of cave lists and locations not accessible to the general public. Under the No Action Alternative, fluid mineral and mining activities would continue to be regulated by the BLM measures designed to lessen impacts to caves and cave resources.

4.2.4.3 Mineral Resources

Under the No Action Alternative, the following impacts would be expected:

- The remaining potash resource in the proposed solution mining areas would not be recovered, resulting in the loss of the resource and loss of revenues, taxes, and royalties. The impact would be significant because the loss of the resource would be irretrievable unless another practical method could be found to extract the resource safely.
- Intrepid's total acreage of federal potash leases would not be allowed to exceed the current 96,000-acre maximum in New Mexico, per 43 CFR §3503.37, as amended.

4.2.4.4 Paleontological Resources

Impacts to paleontological resources under the No Action Alternative may occur due to the potential unauthorized collection of fossils. Due to the low PYFC of the geologic formations and few documented paleontological resources, the potential for adverse impacts to paleontological resources is low.

4.2.5 Alternative A—Proposed Action

4.2.5.1 Geological Hazards

Subsidence

Evaporite karst is an ongoing and documented process in the areas where the Rustler Formation outcrops or is very close to the surface in the Nash Draw and vicinity including the project area (Powers and Owsley 2003b). Karst features include caves, sinkholes, dolines (broad depressions), collapse valleys (swales). Direct effects from subsidence can include pushed up well casings, damaged or failed well casings, cracking and fissuring of the ground, damaged or broken pipelines or other buried utilities (Gallaway et al. 2008). Sudden collapse without obvious warning may occur, or migration of a void to the surface is often accompanied by gentle ground deformation prior to collapse. Indirect effects are often alteration of surface drainage commonly resulting in impoundment of runoff or "sinking streams," disruption of shallow water tables, livestock or wildlife loss, and public safety hazard. Components of the Proposed Action most at risk are facilities such as wells (injection, extraction, and supply); water pipelines; lined ponds; and roads.

There are important differences between natural subsidence and subsidence caused by mining. Mining subsidence can be more predictable than natural subsidence. The following paragraphs describe in detail how mining subsidence has and would most likely occur in the future for both traditional mining methods and solution mining.

The surface effects from the collapse of room-and-pillar workings depend on the depth and geometry of the workings, as well as the strength and integrity of the pillars and the surrounding and overlying strata. The amount of subsidence realized at the surface is dependent on the depth, width, and thickness of the minerals extracted, the ratio of the extracted void (mined out area) to the retained pillar area, and the extent of area over which underground pillar failure takes place.

The maximum depth of subsidence that could occur cannot exceed the thickness of the zone of mineral extracted (i.e., the mining thickness) (Van Sambeek 2008). Maximum subsidence depth is seldom observed, due to one or more of the following reasons:

- Subsidence spreads over an area somewhat larger than the mined area, so the depth of subsidence is proportionately less than the total mined area.
- Convergence, or closure of the mined area, is never fully complete or total. Therefore, some voids remain, reducing the amount of subsidence.
- The overlying strata (i.e., overlying rocks) expand slightly in volume due to breakage as the ground moves downward into the mined area, resulting in a "bulking" effect, which contributes to a reduction in total subsidence volume and depth.
- The subsidence process can be slow for rocks that creep—several hundred (or more) years may be required for complete subsidence to occur.

It is important to note that both historic data and anecdotal evidence suggest that for the southeastern New Mexico potash mines, virtual completion of the maximum surface subsidence profile occurs within just a few years (5 to 7 years) after completion of second mining (Intrepid Potash Inc./Shaw 2008b). Because potash and other salts are classified as an elastoplastic rock, minor, protracted subsidence or creep may continue to occur over an extended period of time. Elastoplastic rocks are massive, homogeneous, and relatively elastic, possessing load-deformation characteristics that deviate significantly from a straight line.

Historic data and observations of subsidence effects in the potash areas of southeast New Mexico have demonstrated that the relationship between the extent of vertical surface subsidence and the thickness of the mining horizon varies with the degree of extraction. For full extraction (100 percent) of the mineable zone, it is considered likely that the maximum surface subsidence will approach the thickness of the mined zone. This is due to evidence suggesting that there is very little breakup and bulking occurring in the overlying strata, which tends to limit the degree of subsidence. There is direct evidence of this phenomena from mining activity that was conducted in supposed "caved" hanging walls about 50 to 100 feet above the earlier mined horizons. In those caved hanging wall applications, the ore beds suffered no noticeable structural deformation other than the elevation differential induced by subsidence (Golder and Associates 1979).

Within the Salado Formation, the First Ore Zone is present at a horizon approximately 500 feet below the top of the formation. Due to variations in thickness of the overlying formations and the dip of the beds, the First Ore Zone can occur from about 675 feet to 1,450 feet below ground surface. Most areas of the target HB potash mines were extracted in a zone 6.5 feet thick or less, with an average mining thickness of about 5 feet (Intrepid Potash, Inc./Shaw 2008b; RESPEC 2011). For this reason, surface subsidence over the HB Mine area proposed for in-situ solution mining would not be expected to be as great as that for surrounding mines with thicker ore extraction heights. Information to further support this conclusion can be found in the technical support document, titled "Regional Geology; Geology and Minerals Issues Related to the Proposed HB In-Situ Solution Mine Project" (AECOM 2010b).

According to Intrepid Potash records, during the period when PCA operated the targeted HB mine workings, approximately 63 percent of the ore reserve was extracted during what was referred to as "first mining" (Intrepid Potash, Inc./Shaw 2008b). Removal of that percentage of the ore reserve typically results in a corresponding decrease in the available cross-sectional area remaining to support the overlying rock and an increase in the magnitude of vertical stress on the ore in the remaining pillars. The increase in vertical stress is offset by the plastic nature of the salt (i.e., the salt adjusts for the change in stress through very slow, flow-like movements) and through redistribution of the stresses to the edges (the surrounding intact rock) of the mine workings. This pressure redistribution is referred to as "arch action."

Once “first mining” was completed, retreat or “second mining” was carried out by removing certain portions of the pillars and barriers in order to increase overall ore recovery. This second mining was typically accomplished by taking cuts through the center of the pillars, generally 90 degrees offset from each other to preserve four corners of each pillar for support. The pillar remnants may be insufficient to support the overlying ground because the stress must be carried over a reduced cross-sectional area. The increase in localized stress is sufficient to cause failure of the pillar remnants.

Pillar failure occurs shortly after second mining is completed, typically within about one month after second mining (Intrepid Potash, Inc./Shaw 2008b). Shortly after the secondary removal cuts are made within the pillar, the residual corner pillars typically begin to compress or crush due to the increased vertical stress from the overlying rock. The pillars generally slough or spall off at the midriff of the pillar so the pillar ultimately assumes an hour-glass shape. The sloughing and spalling action causes debris to accumulate on the floor surrounding the pillar. In the advanced stages of compressive action (as closure or full convergence of the mining void is approached), the roof may receive some support from the debris pile or underground backfilling from non-economic material within mined-out areas, ultimately delaying or precluding full convergence in a localized area of the mine.

During the second mining of the target inactive workings, the company extracted a nominal 20 percent of the remaining ore in place (of the 37 percent that remained as pillars or barriers) (Intrepid Potash/Shaw 2008a). As a result, the total extraction rate (percent calculated as = 0.63 + [0.20 x 0.37]) reached approximately 70.4 percent of the ore reserve in the mines.

Second mining was employed extensively throughout the HB Eddy Mine in order to increase ore recovery. While subsidence was generally observed to begin within one month following completion of second mining, various studies indicate that small settlements of 1 to 2 inches continued to occur several years thereafter.

Several subsidence studies were conducted in the late 1950s by United States Potash (Intrepid Potash, Inc./Shaw 2008c). Findings from these studies suggest that first mining ore removal had the potential to influence the surface at about 20 percent of the mined height, with second mining contributing an additional 50 percent of the mined height. Thus, the total surface expression of subsidence over a 6-foot-thick nominal mining zone would approximate 4.2 feet (calculated as [0.2 x 6 feet] + [0.5 x 6 feet]).

Predicted Subsidence Effects Associated With Proposed Solution Mining

In its most general form, solution mining is the process of extracting soluble minerals such as potash by:

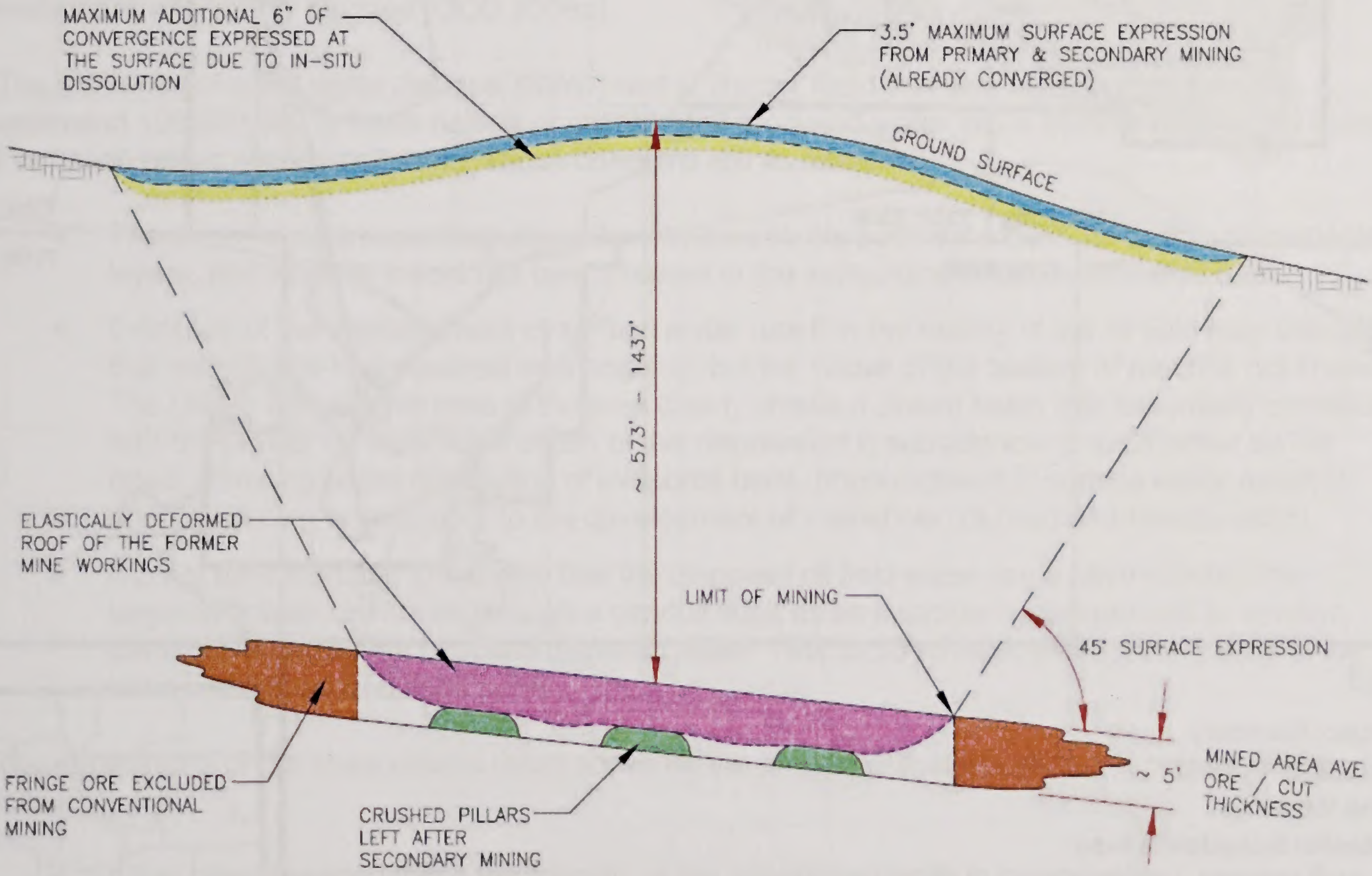
- Introducing a reactionary fluid into the subsurface.
- Dissolving the mineral or rock and forming a brine.
- Recovering the brine.
- Extracting the mineral from the brine (usually by evaporation).

Solution mining typically involves creating underground cavities that are filled with a brine solution, which may be located in bedded salts, salt domes, or salt anticlines. The proposed project exhibits a maximum mined thickness ranging between 5 and 7 feet in the First Ore Zone, which physically limits the size of the solution cavity.

Solution mining of potash ore has been performed at the former Texas Gulf mine (now owned and operated by Intrepid) in Moab, Utah. The solution mining in Moab occurred after the conversion from conventional room-and-pillar underground mining techniques. Solution mining at this location was successful in particular because of the large surface area of potash ore presented by the original room-and-pillar workings of the mine. Since initiation of solution mining, the potassium oxide content of the brine pumped to the surface has continuously diminished with leaching of the mine pillars; however, there has been little indication of active dissolution occurring in ore beyond the original workings (Williams-Stroud et al. 1994).

There are very little data or documentation available to allow analysis of the effects of solution mining on previously mined areas or the associated incremental subsidence. However, it is understood that solution mining would further remove potash ore and correspondingly, result in incremental subsidence effects based on information available regarding subsidence effects induced by room-and-pillar mining. The in-situ solution mining process would result in solubilization of ore from exposed remnant pillars and debris piles, with a lesser contribution expected from wall and floor rock. Wall and floor rock define the transition or contact zone between the ore and surrounding host rock. There would be some control in the in situ process because the injectate would be conditioned to selectively dissolve KCl through an ion exchange process. It is anticipated that a replacement lattice of NaCl would remain within the residual contact zone. Thus, the volume of NaCl precipitated correspondingly "reduces the potential for convergence and surface subsidence volume" (Van Sambeek 2008). Therefore, the remaining support of non-collapsed residual pillars or debris piles is not expected to dissolve to completion. The structural features would likely still function to partially support the overlying rock materials.

Because some subsidence has already occurred, the in-situ process may cause subsidence seen at the surface by an additional 10 percent of the overall mined height (Intrepid Potash, Inc./Shaw 2008a). For the average 6-foot mining height, this would represent a nominal 0.6 feet of additional subsidence at the surface (see **Figure 4.2-1**). The predicted overall maximum surface subsidence expression is about 4.8 feet. **Figure 4.2-2** shows the extent of the area where subsidence is likely to occur as a result of implementing the Proposed Action.


MAXIMUM ADDITIONAL 6" OF CONVERGENCE EXPRESSED AT THE SURFACE DUE TO IN-SITU DISSOLUTION
3.5' MAXIMUM SURFACE EXPRESSION FROM PRIMARY & SECONDARY MINING (ALREADY CONVERGED)
GROUND SURFACE
~ 573' – 1437'
ELASTICALLY DEFORMED ROOF OF THE FORMER MINE WORKINGS
LIMIT OF MINING
45° SURFACE EXPRESSION
~ 5'
MINED AREA AVE ORE / CUT THICKNESS
FRINGE ORE EXCLUDED FROM CONVENTIONAL MINING
CRUSHED PILLARS LEFT AFTER SECONDARY MINING

Source: Intrepid Potash, Inc./Shaw 2008a

Figure 4.2-1 Representative Subsidence Cross-section

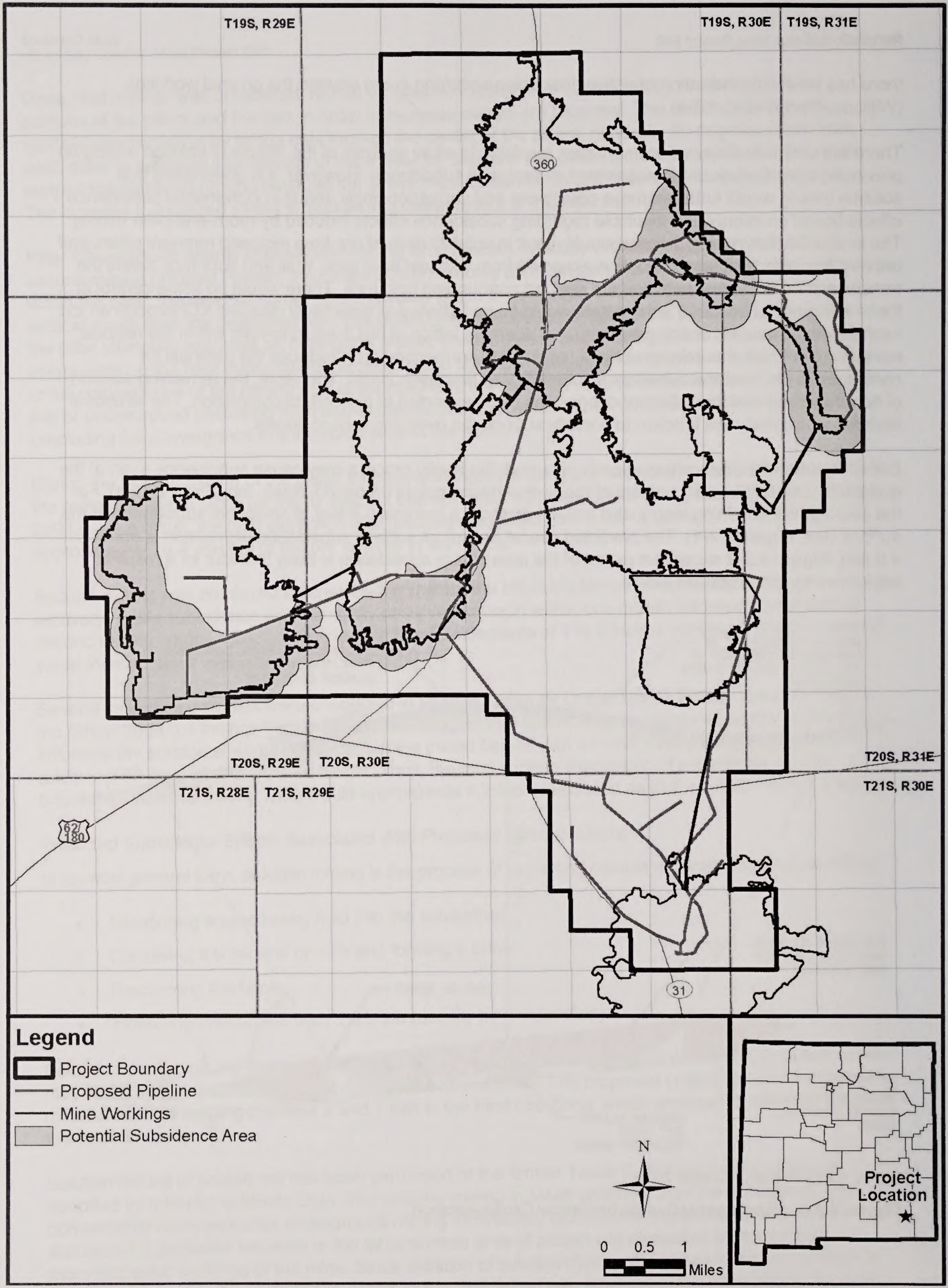


Figure 4.2-2. Potential Subsidence Areas

Due to the widespread areal distribution of the proposed in-situ process throughout the project area, this additional 0.6 feet of subsidence would likely manifest itself very gradually over a few years. It is highly probable that such gradual deformation would result in the development of wide-area, gentle depressions rather than localized, abrupt changes in the ground surface.

The solution mining proposed by Intrepid would not be conducted in the same manner as the brine extraction operations in the region. This is due to the use of brine injectate and the development of a replacement lattice of NaCl that would stabilize the remaining rock, as described above. Therefore, the proposed solution mining would not result in the catastrophic collapse and the creation of large, deep sinkholes that occurred following brine mining, as described in Section 3.2.3.1.

Hazards Related to Oil and Gas Activities

Oil and gas activities raise concerns for the proposed project due to the questionable integrity of some of the casings in the older oil wells and the inadequate abandonment procedures of wells located in and near the proposed flood zones. The HB South inactive workings that would be flooded under the Proposed Action are located above the producing formations of the Barber Oil Field. Active and abandoned oil wells and a salt water disposal well extend through the inactive mine workings targeted for solution mining (see **Figure 3.2-7**). There are no active wells located within the proposed flood zone. The salt water disposal well operated for many years to dispose of produced water in a shallow zone in the Rustler Formation, which, based on logs of nearby oil wells, may have included the Magenta Dolomite. Most Barber Field wells, active or abandoned, are located within a shallow closed depression. Another critical area of concern is the Getty Oil Field at the HB Eddy Mine. Although the Getty Field is now abandoned and is not located within the proposed flood zone, the integrity of the wells are still a concern to nearby potash mines and groundwater quality because records indicate that not all of the wells were adequately plugged (OCD 2009a).

The existence of a salt water disposal (SWD) well at Barber Field that was used to dispose of an estimated 100,000,000 or more barrels of unsaturated produced water into a shallow zone in the Rustler Formation poses serious concerns. Those concerns are as follows:

- There are no data regarding where the water went, the potential extent of solution of evaporite layers, and whether a void has been created in the subsurface underneath the oil field.
- Evidence of the impoundment of surface water runoff in the vicinity of the oil field may indicate that subsidence has occurred or is ongoing, but the cause of the backup of runoff is not known. The USGS topographic map of the area clearly shows a closed basin that essentially coincides with the Barber Oil field. If the cause of this depression is subsidence, it could either be the result of mining or the dissolution of evaporite beds. Impoundment of surface water runoff is often a warning or precursor to the development of a sinkhole (Dunrud and Nevins 1981).
- It is not unreasonable to assume that the disposed oil field water could have reached the targeted potash ore zones through a conduit such as an improperly plugged well or solution cavities created by uncontrolled disposed water. This could adversely affect the quality of the brine in the proposed flood pools.

The implications of the observations listed above for the proposed solution mining of potash are listed as follows:

- It has been asserted that if the integrity of the abandoned wells is compromised, upward flow from the oil-producing Yates Formation would prevent in-situ brine mining water from flowing into an abandoned well bore (Schowengerdt 2009). Given the 70 or more years of oil production, there is likely no hydraulic head in the old wells to prevent fluids from migrating down an abandoned well casing from a potash flood zone. Fluids can enter the well either through an improperly plugged well, or through active wells that are in communication with the salt section.

If the integrity of the well casing or cement has been compromised, unsaturated fluids can flow outside of the wellbore and cause dissolution of evaporate zones and create voids.

- All wells in or near the flood zone should be cause for concern as a source of unintentional brine contamination, not just the wells in the flood zone. A "good plug" might not be of much value if during the well's operational life, communication to the salt section was accomplished through lack of maintenance and casing corrosion.
- In abandoned wells where drilling mud was left in place and cement plugs were either placed over short intervals or not placed at all, the mud and short plugs may not provide an adequate seal to prevent migration of fluids.
- Because of uncertainties related to operational well integrity and proper plugging, the reported 100-foot barrier pillars that were left around oil wells do not guarantee that these pillars would provide adequate protection against the migration of fluids. No information is available to evaluate the current condition of the pillars.
- A produced water disposal zone located above the salt layer may adversely affect the ability to conduct solution mining successfully. It also may reduce surface stability and surface use by oil field surface facilities and solution mining infrastructure.

Caves/Karst

There are a number of potential impacts to karst and cave resources under the Proposed Action. The primary impact to caves would result from groundwater drawdown caused by pumping water from the Rustler Formation (see Section 4.3 for a more detailed discussion of projected groundwater drawdown). Two pumping scenarios were modeled under the Proposed Action, one for a preferred calibration and one for an enhanced calibration. Under the preferred calibration scenario, it is estimated that 42 known caves may be adversely affected by project-related groundwater drawdown. These 42 caves, of the 106 known caves located where the groundwater table is currently within 90 feet of the ground surface, are located in an area where the groundwater would be drawn down below the elevation of the deepest cave (90 feet from the surface). Under the enhanced calibration scenario, 43 caves may no longer be within the 90-foot top of groundwater elevation. The uncertainty of impacts to caves from drawdown is due to the lack of detailed information on the species and depth to groundwater existing in the caves, as well as the many variables affecting the extent of drawdown, exemplified by the use of two calibration scenarios for groundwater modeling. To account for unrecorded caves and karst features that may be affected, the acreage of high and medium cave potential can be used to aid in determining the extent of potential impacts due to drawdown.

Table 4.2-1 summarizes the number of known caves and the acreage of cave potential ratings (see **Figure 3.2-8**) that are likely to be adversely affected by groundwater drawdown. If these caves currently rely primarily on the existing groundwater table to supply water that supports cave-dwelling species, then they would be adversely affected by the groundwater drawdown associated with the Proposed Action. In this situation, the effect of groundwater drawdown would be significant because it would result in a loss of unique cave resources or values. Detailed biological inventories and groundwater level monitoring in caves would be needed to evaluate the full extent of the impacts.

Table 4.2-1 Caves or Karst Features Affected by Groundwater Drawdown under Proposed Action

Features Affected by Drawdown	Preferred Calibration Groundwater Pumping Scenario	Enhanced Calibration Groundwater Pumping Scenario
Known Caves (no.)	42	43
High Cave/Karst Potential Area (ac.)	25,668	26,720
Medium Cave/Karst Potential Area (ac.)	6,168	6,651

Table 4.2-1 Caves or Karst Features Affected by Groundwater Drawdown under Proposed Action

Features Affected by Drawdown	Preferred Calibration Groundwater Pumping Scenario	Enhanced Calibration Groundwater Pumping Scenario
Low Cave/Karst Potential Area (ac.)	15,112	15,166

Note: Numbers and acreage calculated by determining the quantity of caves and cave potential ratings that would no longer be supplied by the groundwater table within 90 feet of the ground surface.

Other potential adverse impacts to caves and karst features include the following:

- New access roads in the project area would increase the opportunity for public entry and disturbance or damage to cave resources.
- Drilling into unrecorded cave/karst features may allow water from drilling fluids and mud to enter a solution cavity and contaminate groundwater or dissolve evaporite strata. This may pose risks to groundwater quality, health and safety, roads, structures, and may alter surface water runoff patterns.
- Construction and drilling operations would pose a threat to cave and karst resources by weakening the roof of an unrecorded solution cavity. If a shallow cave or karst feature were affected, this could cause a near-surface collapse of the roof and damage or injury to drilling equipment and personnel.

4.2.5.2 Mineral Resources

The Proposed Action would have the beneficial impact of recovering additional potash reserves that would probably not be recoverable with conventional mining methods. There would be no change to access to oil and gas exploration and development in the project area.

Under the Proposed Action, the maximum acreage of Intrepid's allowable potash leases in New Mexico would increase, enabling Intrepid to continue to extract potash beyond the current acreage of federal leasing limits. This would not, however, affect oil and gas development because the existing BLM leasing and management guidelines, based on the 1986 Order, OCC Order R-111-P, and IM NM-2011-003 (see **Appendix A**) would continue to be implemented.

4.2.5.3 Paleontological Resources

Paleontological resources would be at risk for direct adverse impacts (destruction or damage) from pipeline and well pad construction activities and well drilling through fossil-bearing formations.

Indirect impacts during construction may include erosion of exposed fossil beds due to slope regrading and vegetation clearing, or the unauthorized collection of scientifically important fossils by construction workers or the public. Unauthorized collection may increase due to increased public access to fossil localities from the construction of new maintained access roads.

There is a low risk of adverse impacts to fossils under the Proposed Action. Given the low PFYC rating of surficial deposits and the limited potential for the Rustler Formation to contain scientifically important fossils, especially vertebrates, impacts to paleontological resources area expected to be small.

4.2.6 Alternative B

Most of the impacts to geological resources under Alternative B would be the same as those described for Alternative A, Proposed Action. Pumping from the Caprock well fields would reduce the quantity of Rustler water to be used, so the groundwater drawdown in and near the project area would be less.

Fewer known caves and less acreage of high and medium cave potential areas may be adversely affected by Rustler well pumping under this alternative. **Table 4.2-2** summarizes the caves and karst areas that would be affected by groundwater drawdown.

Table 4.2-2 Caves or Karst Features Affected by Groundwater Drawdown under Alternative B

Features Affected by Drawdown	Preferred Calibration Groundwater Pumping Scenario	Enhanced Calibration Groundwater Pumping Scenario
Known Caves (no.)	18	38
High Cave/Karst Potential Area (ac.)	10,977	23,961
Medium Cave/Karst Potential Area (ac.)	2,949	5,832
Low Cave/Karst Potential Area (ac.)	1,537	1,921

Note: Numbers and acreage calculated by determining the quantity of caves and cave potential ratings that would no longer be supplied by the groundwater table within 90 feet of the ground surface.

No additional adverse effects to geological resources are anticipated from the use of the Caprock well fields and construction of new pipelines or replacement of existing pipelines to provide supplemental water.

4.2.7 Alternative C

The risk of impacts to geological resources under Alternative C would be the same as those described for Alternative A, Proposed Action. The pipelines in the project area would not be buried deep enough to affect the underlying bedrock, caves, or fossil-bearing formations.

4.2.8 Alternative D—Preferred Alternative

Impacts to geological resources under the Preferred Alternative would be similar to those described under Alternative B. Minor changes to the pipeline layout in the northwest portion of the project area within the HB Eddy inactive workings would reduce the potential for impacts to karst features under the Preferred Alternative. The number of caves potentially affected by groundwater withdrawal would be the same as under Alternative B. The reclassification of potash mining leases to solution mining leases would have no effect on potash recovery or other mineral extraction (oil and gas).

4.2.9 Mitigation Measures

Recommended additional mitigation measures to minimize project-related impacts are listed in the following sections.

4.2.9.1 Subsidence

Intrepid has committed to developing and implementing a subsidence monitoring plan using a monitoring network that is already in place. Readings at the established monitoring locations would begin before the groundwater pumping and brine injection into the flood pools begins in order to establish a current baseline of the ground surface elevation. The subsidence monitoring plan would identify the monitoring locations, schedule, evaluation methods, and reporting procedures. The plan would be reviewed and approved by the BLM. It is recommended that measurements occur at regular intervals (monthly or quarterly).

Intrepid would follow the requirements listed in Section 2.4.5 with more detail provided in **Appendix B**. The protection measures would be followed for the construction of wells, roads, pipelines, and utilities.

4.2.9.2 Caves/Karst

To avoid or minimize the risk of damage to cave or karst features from construction and maintenance activities, while also avoiding the potential for collapse of karst features to damage proposed pipelines, wells, and other project facilities, in addition to the requirements listed in Section 2.4.5, the following mitigation measures are proposed.

- Intrepid should submit a final layout of all facilities for site-specific review and approval by the BLM. Any facilities that cross major karst features, as defined by BLM staff during field inspection, will be moved or modified before final approval for construction is given.
- Monitoring the stability of facilities (pipelines, wells, roads) in karst terrain should be performed on a regular basis to identify and minimize the risk of damage to facilities from ongoing karst development and to protect cave resources.
- A BLM-approved groundwater monitoring plan will be developed to check groundwater fluctuations in critical karst areas. Implementation of the plan will include a biological inventory of species in three caves designated by the BLM before groundwater pumping begins, with subsequent monitoring to determine the extent of impacts on cave water from pumping. Adaptive management strategies will be planned and implemented to mitigate groundwater drawdown that would adversely affect the water supply supporting cave species.

4.2.9.3 Mineral Resources

The requirements listed in Section 2.4.5 would be adequate to protect mineral resources. No additional mitigation measures are proposed. Notwithstanding any decisions of this EIS, oil and gas operations would continue to be conducted in compliance with the 1986 Order, OCC Order R-111-P, IM NM-2011-003, and any lease stipulations described in Section 2.4.5 and detailed in **Appendix B**.

4.2.9.4 Paleontological Resources

The following protection measures are recommended for paleontological resources:

- Construction personnel should be instructed about the types of fossils that could be encountered and the steps to be taken if they uncover potentially significant fossils during construction of the project. Instruction will emphasize the non-renewable nature of paleontological resources and that collection or excavation of fossil materials from federal land without benefit of a federal permit is illegal.
- If fossils are found, the BLM is to be contacted immediately to allow the BLM to determine whether the fossils are scientifically significant and to provide a qualified paleontologist to assess and document the find.
- If fossils are collected, they will be curated at a facility approved by the BLM.

4.2.10 Summary of Impacts

There would be more known caves affected under the Proposed Action and Alternative C than under Alternative B and the Preferred Alternative. For the other resources and issues described in this section, there would be no difference between the impacts under the Proposed Action and the other action alternatives.

4.2.10.1 Subsidence

The in-situ process may result in subsidence of an additional 10 percent of the overall height of the mined ore zone (Intrepid Potash Inc./Shaw 2008a) projected to be approximately 0.6 feet of additional subsidence at the ground surface beyond what has already occurred.

Due to the widespread areal distribution of the proposed in-situ process throughout the project area, this additional 0.6 feet of subsidence would likely manifest itself very gradually over a few years. It is probable that this gradual deformation would result in the development of wide, gentle depressions rather than localized, abrupt offsets of the ground surface.

The duration of subsidence cannot be predicted due to the nature of the salt deposits to deform slowly. Subsidence is likely to occur over an extended period of time, allowing the ground surface to gradually adjust without noticeable signs of subsidence.

4.2.10.2 Oil and Gas Activities

There are a number of concerns and potential impacts regarding past and present oil and gas activities within and adjacent to the proposed flood zones. Concerns that must be addressed include the integrity of active and abandoned wells, a SWD well used for injecting water into strata above the proposed solution mining zone, and the integrity of barrier pillars in the ore zones around oil well borings. If left untouched there would be potential for contamination that may increase the likelihood of subsidence.

If well integrity concerns can be adequately addressed through due diligence, risk assessment, and proper plugging and abandonment of at-risk wells, residual impacts from oil and gas activities should present minimal or no residual impacts to potash mining.

4.2.10.3 Caves and Karst

The primary risk to caves and karst features would result from project-related pumping of the Rustler Formation, which would lower the groundwater table below the bottom of most caves in and near the project area. Risks associated with cave and karst features include an increased potential for unauthorized public entry and disturbance or damage to cave resources, drilling into cave/karst features and allowing fresh water to contaminate groundwater, dissolve evaporite strata, and result in subsidence.

Development of caves and karst features is a natural process that can be accelerated by human activities. It is expected that the risks and concerns related to karst formation would continue well beyond the life of the proposed project. Protective measures described would reduce the risk, but cannot be fully mitigated or avoided.

4.2.10.4 Mineral Resources

The proposed project would have the beneficial impact of recovering additional potash resource that would probably not be recoverable using conventional mining methods. It also would increase Intrepid’s maximum allowable total acreage of federal potash leases in the state. There would be no change in access to potential oil and gas resources.

The extraction of recoverable potash resources is an irretrievable and irreversible residual impact associated with the proposed project.

4.2.10.5 Paleontological Resources

Paleontological resources would be at risk for direct adverse impacts (destruction or damage) from pipeline, well pad, road construction activities, and well drilling. Given the low PFYC rating of surficial deposits and the Rustler Formation to contain scientifically important fossils, especially vertebrates, impacts to paleontological resources are expected to be small.

The proposed protection measures may not protect all fossil resources. Unauthorized collection and inadvertent destruction of fossil resources would continue as residual impacts and require continued enforcement of federal laws and BLM policy.

4.3 Water

4.3.1 Issues

Issues related to water resources that have been identified for the proposed project include:

- Impacts to surface runoff drainage patterns caused by surface infrastructure blocking flows.
- Potential for increased erosion by surface water due to ground disturbance and trenching activities
- Possible water contamination from evaporation ponds
- Drawdown of groundwater levels through pumping for proposed mining operations
- Potential decrease in groundwater contributions to Pecos River

4.3.2 Method of Analysis

4.3.2.1 Surface Water

Surface water impacts were assessed through Geographic Information System (GIS) analysis of:

- Proposed areas of disturbance within subwatersheds.
- Areas up-gradient from project disturbance locations.
- Areas near or crossing existing drainage-ways and floodplains.

Subwatershed boundaries were defined using the WBD (NRCS 2005). Existing drainageways were defined by the NHD high resolution dataset (USGS 2009b), and floodplains were defined by the National Flood Insurance Program, Zone A 100-year floodplains (FEMA 1991).

4.3.2.2 Groundwater

Groundwater impacts were analyzed through the use of groundwater flow models to estimate the potential availability of groundwater for the proposed project and to predict drawdown to groundwater levels compared to existing water levels in the area.

The groundwater system in the project area and impacts from pumpage of the Rustler North and South wells in the project area were evaluated using the numerical model MODFLOW 2000 (Harbaugh et al. 2000) running within Groundwater Vistas model processing software, developed by Environmental Simulations, Inc. (2007).

The Caprock aquifer and pumpage of the Caprock wells was represented through utilization of the analytic element model GFLOW, version 2.1.2 (GFLOW 2007).

Both models were used to define drawdown impacts near the pumping area, and the predictive capability diminishes near the model domain boundaries. More details on the groundwater modeling can be found in the technical report, Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS prepared for the BLM (AECOM 2010b).

Rustler Groundwater Model

The Rustler groundwater model domain encompasses Clayton Basin, the upper half of Nash Draw, Livingston Ridge, and Quahada Ridge, extending across T19S through T22S, and R29E through R31E (R28E through R30E in the south). These features can be located on **Figure 3.3-1**. Flow through the Magenta and Culebra dolomite members constitute the aquifers in the Rustler Formation, with groundwater movement flowing from north to south. The aquifers outcrop and end at Nash Draw to the south. Considering these conditions, the western and northeastern boundaries were modeled as no-flow boundaries, and the remaining boundaries were constant head boundaries. The total area of the model domain is approximately 429 square miles, measuring 17.6 miles from west to east and 24.4 miles from north to south. The model grid cells are a uniform 1,000 square feet each, with six layers representing the Dewey Lake Red Beds (including overlying alluvium) and the five members of the Rustler Formation (Forty-niner Member, the Magenta Dolomite, the Tamarisk Member, the Culebra Dolomite, and the Los Medaños Member) (see **Figure 3.3-2**). Project water withdrawals were incorporated into the Magenta Dolomite layer of the model.

The model was populated with two sets of aquifer property parameters from published sources and field investigations performed for Intrepid. The model was then calibrated with water levels that have been measured over time. Calibrations indicated that the model met the goals set prior to commencement of modeling. The Rustler model was run using two hydraulic conductivity values created to account for uncertainty based on variations between values from previous studies and recent pumping tests performed for the project. Therefore, two models were developed using different hydraulic conductivity values, the Rustler Preferred Model and the Rustler Enhanced Model.

Rustler Preferred Model

The Rustler Preferred Model was run with a maximum hydraulic conductivity (approximately 180 feet per day), which represents a fracture or fault zone. **Figure 4.3-1** displays the hydraulic conductivity values used in terms of Kx or feet per day.

Rustler Enhanced Model

The Enhanced Model was developed to allow for the maximum possible flow of groundwater from an integrated fracture system that covers the eastern half of the Rustler south area, plus sections in southern Clayton Basin (Rustler north area). The Rustler Enhanced Model was run with a maximum hydraulic conductivity (approximately 100 feet per day) distributed across a more extensive area of approximately 3 square miles. An even larger area with elevated hydraulic conductivity of approximately 10 feet per day surrounded this area. While the maximum hydraulic conductivity is less than under the Preferred Model, it was applied over a larger area resulting in model results that projected higher sustainable pumping quantities from the same model domain. The hydraulic conductivity values applied for this version of the model are possible if the area were located in an interconnected fracture system. **Figure 4.3-2** displays the hydraulic conductivity values in the model domain for the Enhanced Model.

Caprock Groundwater Model

The Caprock groundwater model is distinct from the Rustler model, using a single-layer, analytic element model and a separate model domain. It was created to evaluate the potential drawdown impacts of pumping from the Caprock well field in Lea County to supplement Rustler water sources under Alternative B. The Caprock model is two dimensional, with the Ogallala Formation being the single layer. Aquifer parameters used in the model were provided by NMOSE data and published literature (McAda 1984; Musharrafieh and Chudnoff 1999).

Because GFLOW, version 2.1.2 (GFLOW 2007) cannot model time-sequenced pumping from a single well, modeling of drawdown where the pumping rate changes with time requires either modeling the maximum drawdown case or use of a time-weighted average pumping rate over the life of the well. The Proposed Action model run utilized the time-weighted average over all three phases due to relatively small differences in pumping rates between the maximum drawdown results and the time-weighted average results. Alternative B used two model runs to represent both the maximum drawdown case during Phase I and the time-weighted average to show the drawdown over the life of the proposed project.

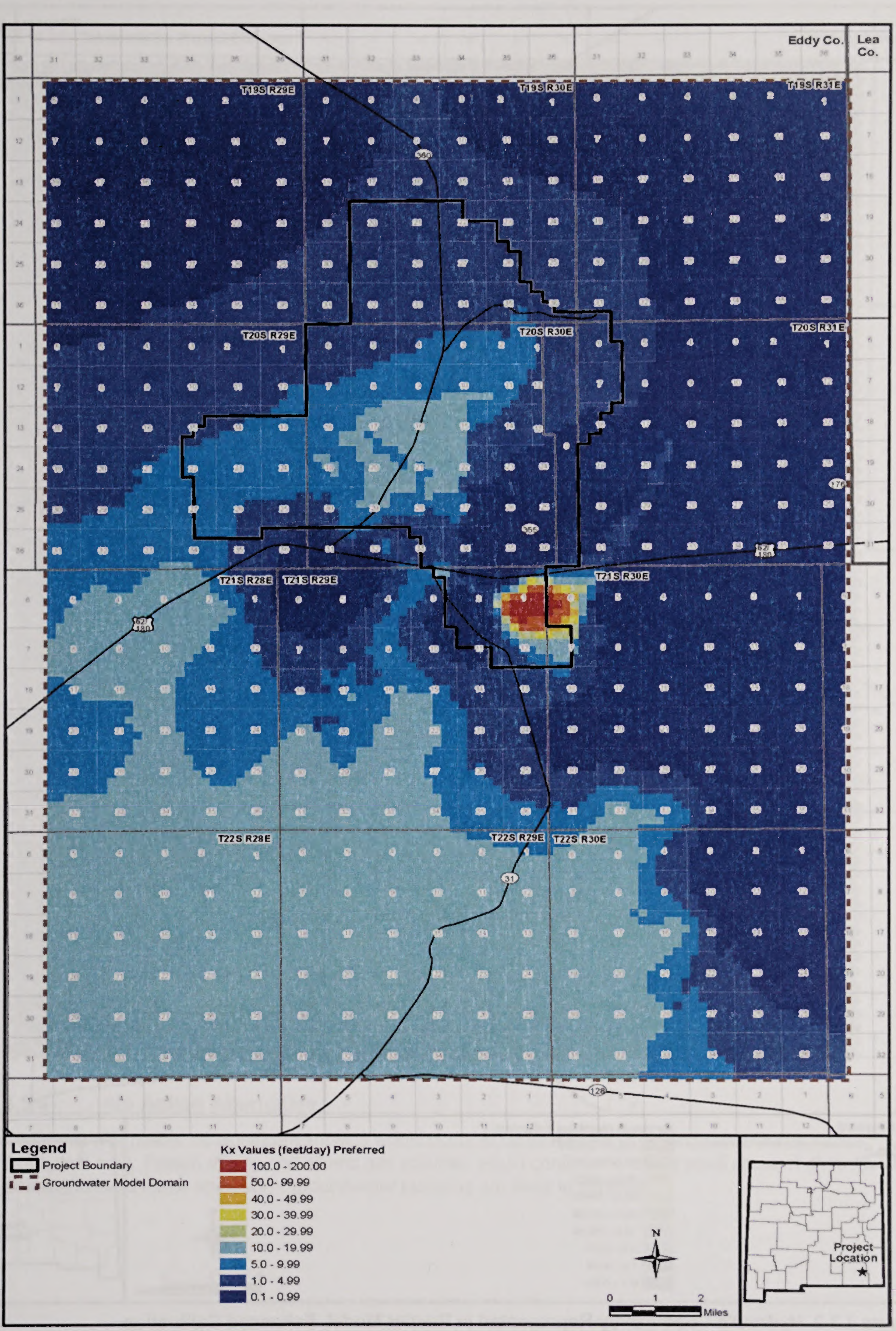


Figure 4.3-1. Hydraulic Conductivity Represented in Rustler Model, Preferred Calibration

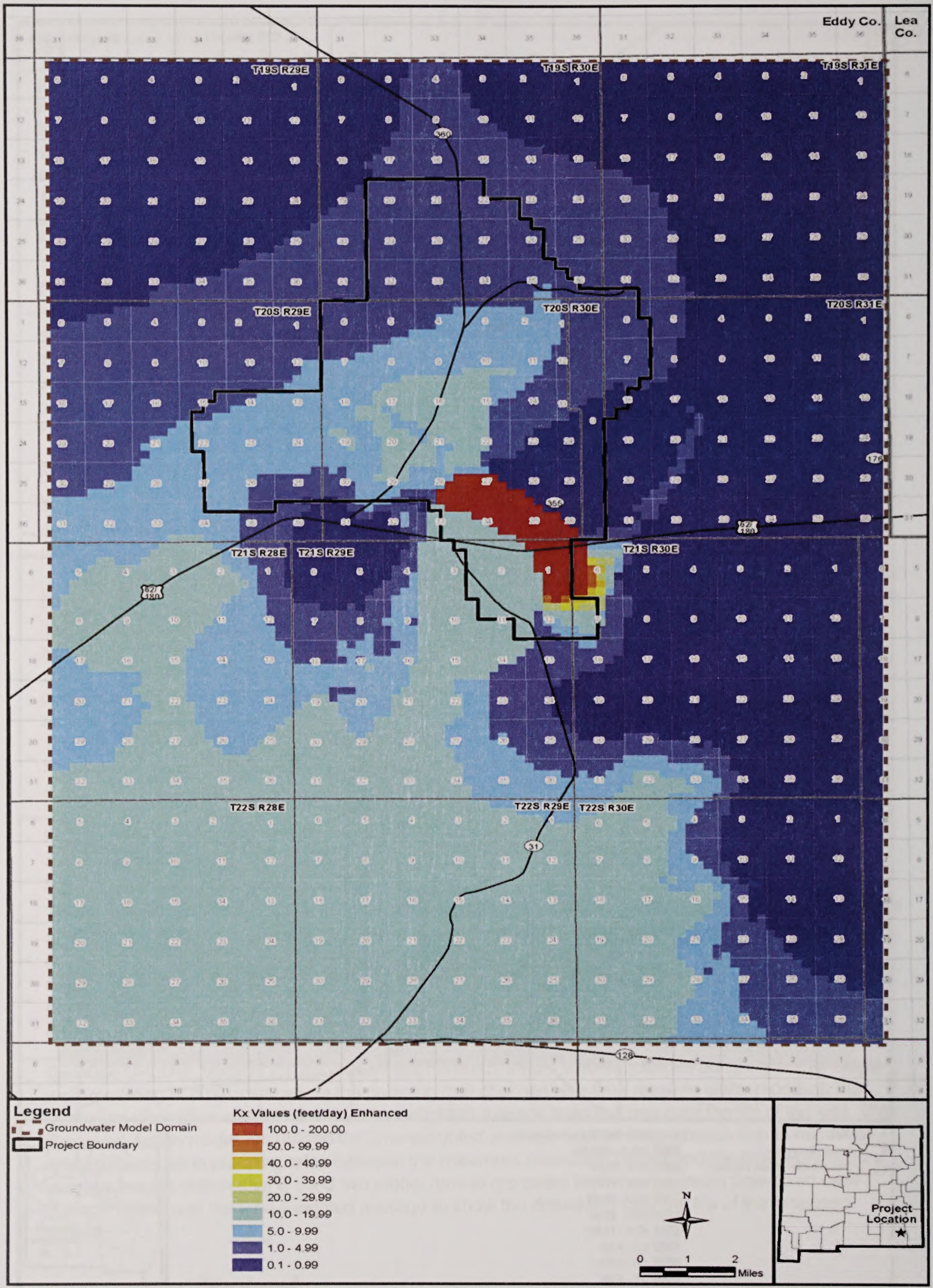


Figure 4.3-2. Hydraulic Conductivity Represented in Rustler Model, Enhanced Calibration

4.3.3 Assumptions

Impacts to water resources were determined based on the location, type of disturbance, and amount of groundwater drawdown from aquifers identified as potential sources of project water.

The following assumptions were used in the analysis of impacts to water resources:

- Hydrologic boundaries and floodplains represented in figures in Section 3.3 (WBD, NHD, FIRMs) are accurate.
- Areas of recently disturbed ground would be more susceptible to erosion.
- Erosion from disturbed areas would be minimal once vegetation or other surface stabilization is established.
- Successful establishment of herbaceous vegetation generally takes a minimum of 3 to 5 years.
- Pipelines crossing drainageways would follow the environmental protection measures for co-located roads and culverts.
- Complex groundwater systems can be adequately portrayed through the representative groundwater models.
- Groundwater level equilibrium currently exists over the model domains.
- Areas where a modeled geologic unit is absent were represented with a constant thickness of 10 feet because layers cannot be absent in MODFLOW models.
- Lead in the former PCA wells in the Rustler North area would have to be removed before it could be used in injectate brine.
- Erosion and sediment control measures and storm water protection measures would be developed and implemented as part of the NPDES Construction General Permit requirements before construction begins. A SWPPP would be developed as part of the NPDES Industrial Storm Water Permit that would apply to the new HB mill. It is assumed that these measures, in conjunction with those listed in Section 2.5.3, would be adequate to minimize adverse impacts to surface water bodies from sedimentation.

Impacts to water resources would be significant if the Proposed Action or alternatives result in one or more of the following:

- Surface infrastructure locations are within 650 feet (200 meters) of 100-year floodplain, playa, or alkali lake.
- Modeled groundwater drawdown precludes supplying the project with required water supply.
- Modeled groundwater drawdown decreases flow contributions from the project area to the Pecos River by more than 1 percent annually, compared to current average annual flow contributions (not to total flow in the Pecos River).

4.3.4 No Action Alternative

Under this alternative, no significant impacts would occur to surface water or groundwater resources in the project area. Potash mining and oil and gas activities would continue to cause small areas of surface disturbance and minor amounts of groundwater pumping are likely to continue.

4.3.5 Alternative A—Proposed Action

4.3.5.1 Surface Water

Under the Proposed Action, temporary disturbance during the construction phase of the project totals 980 acres. After reclamation of temporary disturbance and acreage recovered during the operation phase of the project, long-term disturbance would total 822 acres. Temporary and long-term disturbance within each subwatershed are listed in **Table 4.3-1**. The largest disturbance would occur from construction and operation of the evaporation ponds. Because these ponds will be engineered to contain precipitation along with the extracted mine fluid, once constructed they would not be expected to contribute to off-site erosion impacts. Similarly, the well sites will be constructed with a containment berm along the perimeter, negating any off-site erosion impacts once constructed.

Figure 4.3-3 depicts project component locations within each subwatershed. Initial disturbance in subwatersheds with Project components range from less than 0.1 percent in Scanlon Draw and Lone Tree Draw to 1.5 percent in Clayton Basin. The relatively high percentage of disturbance in Clayton Basin is largely due to the evaporation ponds being largely located here, totaling approximately 1 percent of the subwatershed's area. Considering that no offsite impacts are anticipated from the ponds, this brings the effective initial disturbance down to 0.5 percent. Similarly, in the long-term disturbance, the ponds account for 0.9 percent of the disturbance in Clayton Basin, which decreases the effective long-term disturbance of that subwatershed to 0.4 percent.

Table 4.3-1 Project-related Disturbance within Subwatersheds under the Proposed Action

Subwatershed Name	Initial Disturbance (acres)		Long-term Disturbance (acres)	
	Total	% HUC	Total	% HUC
Little Lake	46	0.2	44	0.1
Clayton Basin	833	1.6	688	1.3
Scanlon Draw	6	<0.1	3	<0.1
Lone Tree Draw	23	<0.1	17	<0.1
Maroon Cliffs	114	0.3	77	0.2
Total	1,022	0.6	829	0.5

[1] Project well site acreage is included in pipeline ROW acreage.

[2] ROW includes project pipelines, wells, roads, lift/pump stations, and power lines.

There are two separate locations where proposed pipeline and road facilities would be located within 650 feet (200 meters) of 100-year floodplains and alkali lakes (**Figure 4.3-4**). These locations are in the NE¼ Section 9 and the NE¼ Section 3, both of T20S, R30E. Both locations are identified in the NHD as intermittent waterbodies. Analysis of aerial photography indicates the waterbody in Section 9 is a dry playa and the one in Section 3 contains water for at least portions of the year.

Aboveground pipelines have the potential to block, divert, and concentrate overland storm water runoff from precipitation events. Surface pipelines may create concentrated flows or back up surface water. Where surface water is backed up behind a surface structure such as a pipeline or a road, the ponded water may overtop the structure and cause erosion on the downstream side. Where the contributing upstream drainage area is 50 acres or more, the potential for concentrated flows that might form gullies or channel headcuts is greater than in smaller upstream drainage areas (larger flows and higher water velocities increase the water's potential to move soil). Intrepid has committed to burying the pipeline every 0.25 mile, which would not allow for large drainage areas to be concentrated along long runs of pipe.

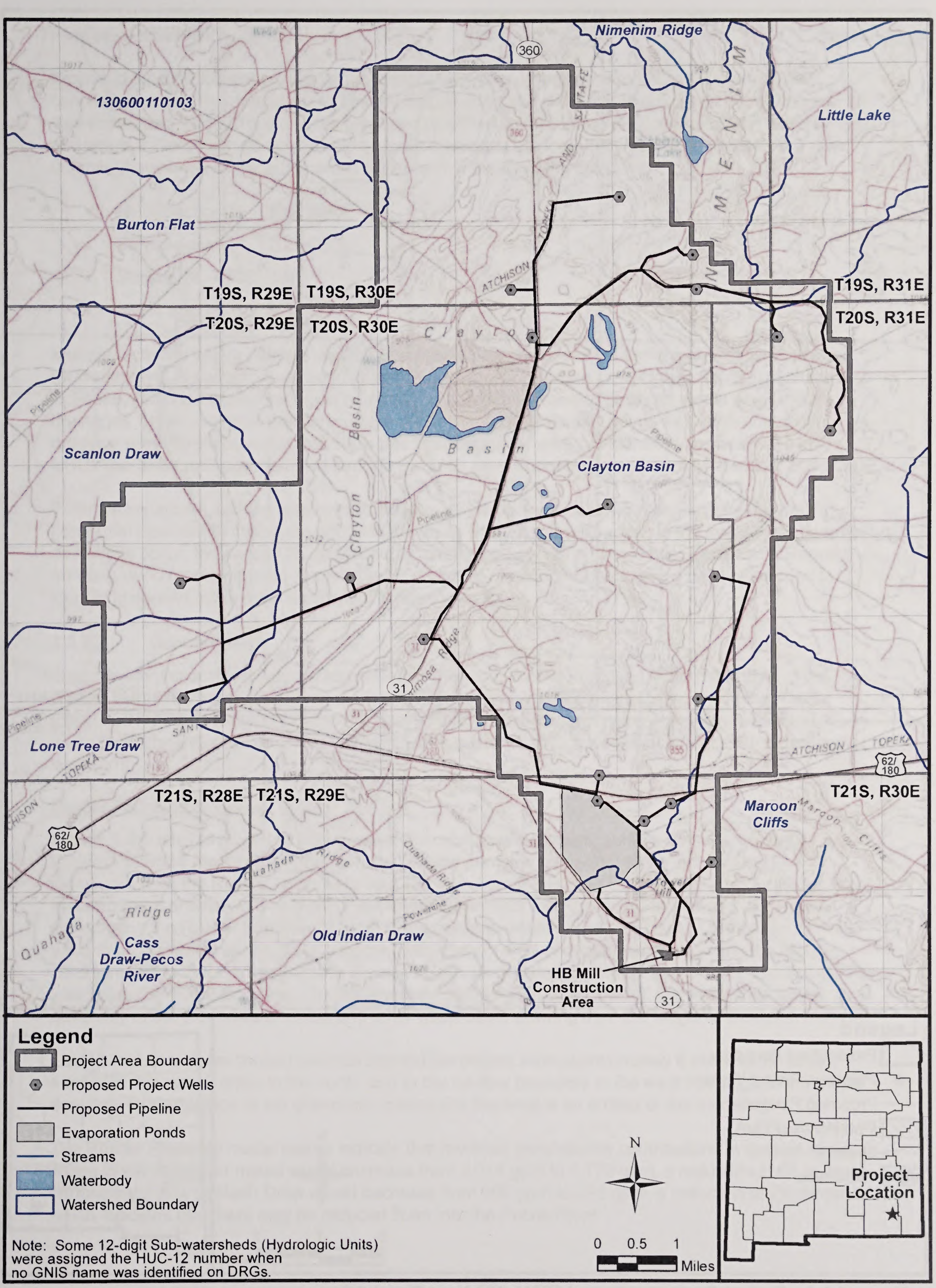


Figure 4.3-3 Project Component Locations with Subwatersheds

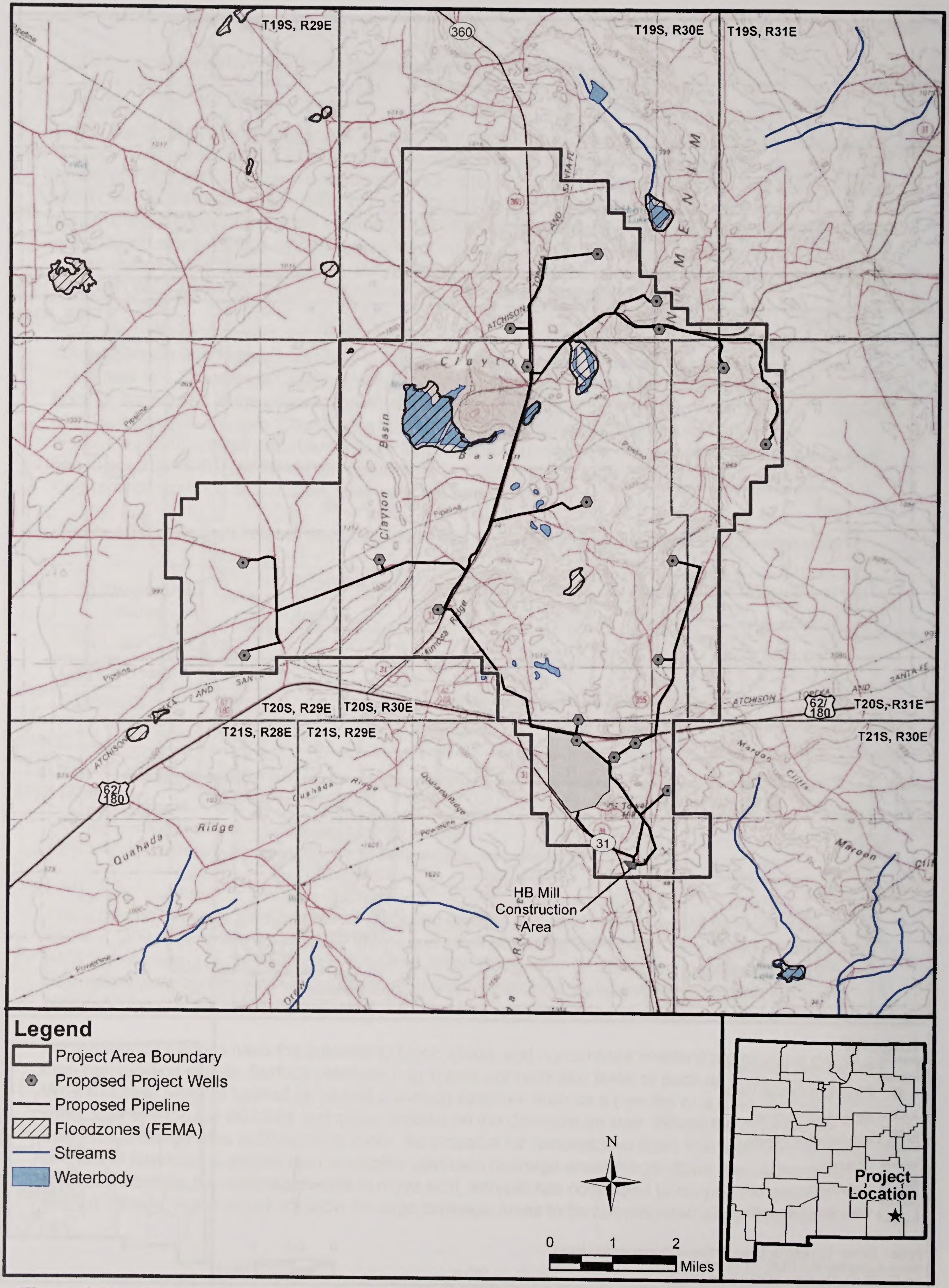


Figure 4.3-4 Project Components and FEMA 100-Year Floodplains

Proposed pipeline locations were largely co-located with existing roadways as well, where runoff concentration and its impacts would already be occurring and likely to be conveyed through culverts or dips in the road. Locations along the proposed pipelines that would not be co-located with existing roads and would traverse across slopes where pipeline sections are long (between approximately 0.2 and 0.5 mile) have been identified as areas of concern in the following locations:

- NE¼ Section 35, T19S, R30E
- SE¼ Section 15, T20S, R30E
- Section 24, T20S, R31E
- NW¼ Section 6, T21S, R30E

Multiple locations where pipeline and road facilities would cross existing surface water flow drainages (or waterways) of concern have been identified through GIS analysis (see **Figure 4.3-5**). There are nine locations, identified through analysis of the NHD, where the proposed pipelines would cross existing drainages. There are three locations where surface pipelines intersect points with large contributing drainage areas (from 50 acres to 2,500 acres upstream) that were not identified as waterways in the NHD. The nine crossings identified through the NHD have drainage areas from 10 acres to 2,500 acres.

Potential impacts to existing water resources through ruptures or spills from the pipelines or ponds (abnormal operations) during the operations phases would not be expected. In the event that abnormal operations occur, they would be minimized by automated sensing and shutdown equipment. Regular on-the-ground monitoring and inspections for detection of minor incidents would be implemented to identify leaks and ensure that equipment is running properly.

4.3.5.2 Groundwater

Groundwater impacts were analyzed under two scenarios for the Proposed Action. Pumping of the Rustler North and South areas was modeled with both the Rustler Preferred Model and the Rustler Enhanced Model. The Caprock Model was used to predict drawdown using only a time-weighted average for the life of the project in the vicinity of Intrepid's Caprock well fields under each of the above scenarios.

Rustler Preferred Model

Figure 4.3-6 depicts projected drawdown of the existing groundwater surface that was predicted by the Rustler Preferred model. The maximum sustainable pumping rate under this scenario would be 1,440 gpm from the Rustler North wells and 177 gpm from the Rustler South wells. The results indicate that maximum drawdown would occur in Clayton Basin near the Rustler North well and in the area surrounding the Rustler South wells. Both of these areas would exceed 200 feet of drawdown from the existing groundwater elevations in the area, with a larger area of drawdown surrounding the Rustler South wells due to the larger number of wells being pumped and the higher hydraulic conductivities. The total area of 200-foot drawdown is approximately 1,850 acres. Drawdown of this magnitude would adversely affect groundwater levels and other water users drawing from the Magenta Dolomite member.

The 10-foot drawdown contour extends beyond the project area approximately 6 miles to the south, 4 miles to the east, 2 miles to the north, and to the no-flow boundary in the west (the edge of the model domain). The extension of the drawdown contours to the west is an artifact of the modeling.

The Rustler Preferred model results indicate that modeled groundwater contributions to springs and seeps in the calibrated model would decrease from 3,014 gpm to 1,170 gpm, a reduction of 61 percent. Groundwater flow to Nash Draw would decrease from 306 gpm to 228 gpm, a reduction of 25 percent, which indicates that there may be reduced flows into the Pecos River.

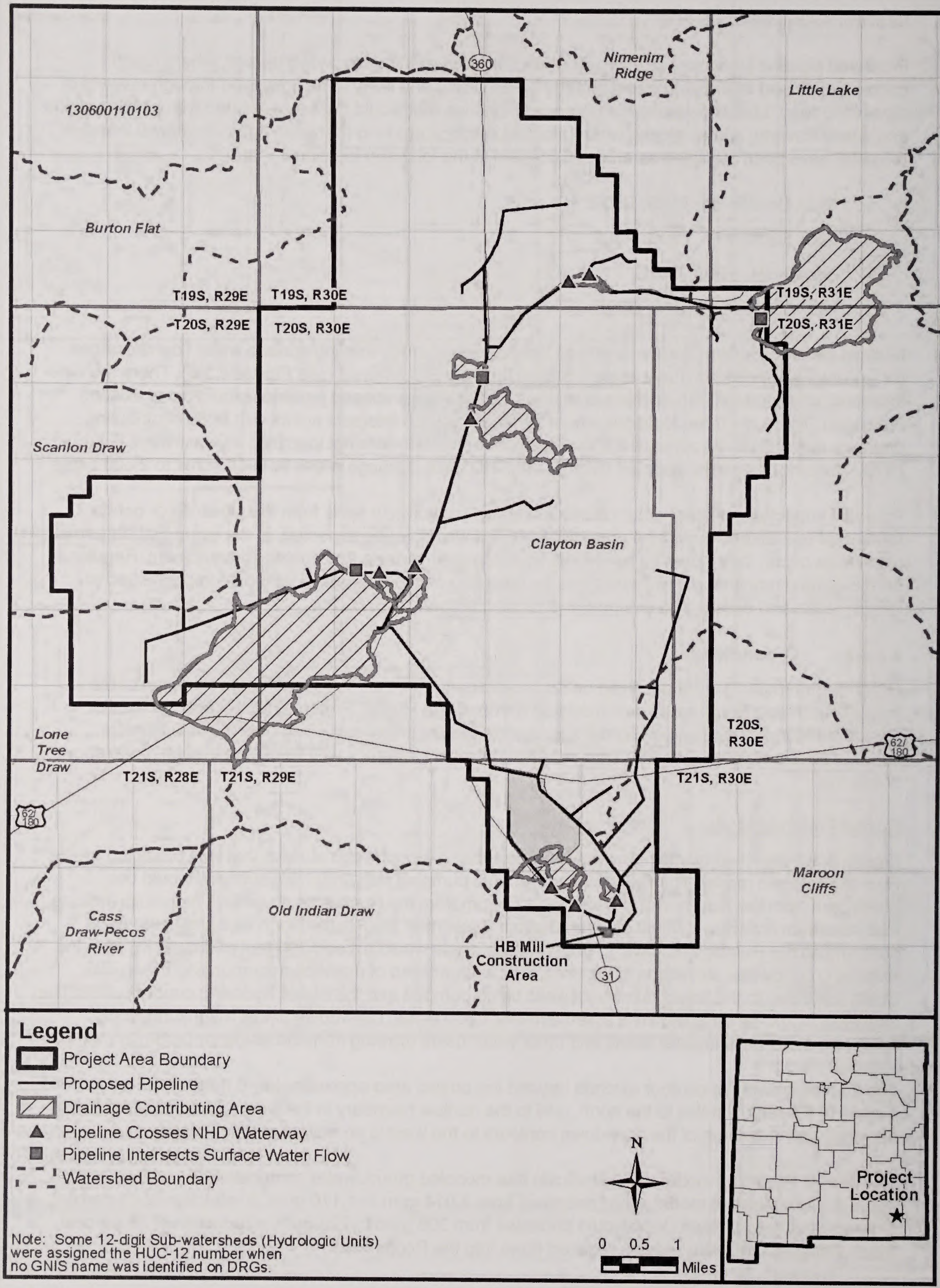


Figure 4.3-5. Drainage Points at Proposed Surface Pipelines under Proposed Action

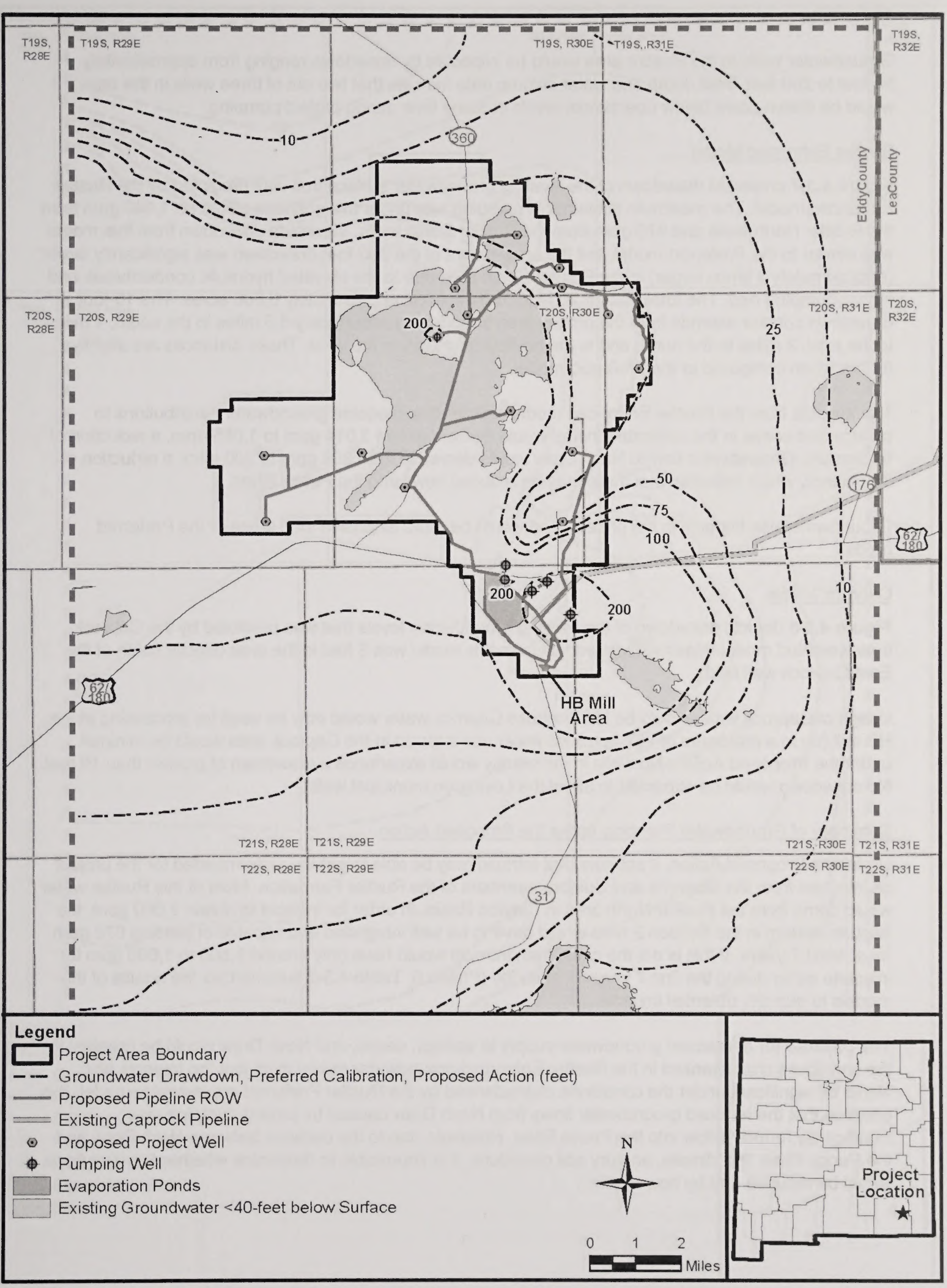


Figure 4.3-6. Groundwater Drawdown, Rustler Preferred Model under Proposed Action

Groundwater wells in the Rustler area would be impacted by drawdown ranging from approximately 50 feet to 200 feet. Well depth and water column data indicate that two out of three wells in the area would be drawn down below operational levels at some time during project pumping.

Rustler Enhanced Model

Figure 4.3-7 projected drawdown of the existing groundwater surface that was predicted by the Rustler Enhanced model. The maximum sustainable pumping rate under this scenario would be 1,440 gpm from the Rustler North wells and 670 gpm from the Rustler South wells. Maximum drawdown from this model was similar to the Preferred model, but the areal extent of the 200-foot drawdown was significantly larger (approximately 3 times larger) in the Rustler South area due to the elevated hydraulic conductivities and higher pumping rate. The total area of 200-foot drawdown is approximately 6,500 acres. The 10-foot drawdown contour extends from the project area boundary approximately 6.5 miles to the south, 4 miles to the east, 2 miles to the north, and to the no-flow boundary in the west. These distances are slightly further when compared to the Preferred model.

The impacts from the Rustler Enhanced model indicate that modeled groundwater contributions to springs and seeps in the calibrated model would decrease from 3,014 gpm to 1,085 gpm, a reduction of 64 percent. Groundwater flow to Nash Draw would decrease from 306 gpm to 200 gpm, a reduction of 35 percent, which indicates that there may be reduced flows into the Pecos River.

Groundwater use impacts in the project area would be more extensive than those of the Preferred model.

Caprock Model

Figure 4.3-8 depicts drawdown of the existing groundwater levels that was predicted by the Caprock time-weighted model. Maximum drawdown from this model was 8 feet in the area directly south of the East Caprock well field.

Usage of Caprock water would be low because Caprock water would only be used for processing at the HB mill (up to a maximum of 267 gpm), so water use impacts in the Caprock area would be minimal under the Proposed Action. No wells in the vicinity would experience a drawdown of greater than 10 feet. No drawdown would be expected to affect the Lovington municipal wells.

Summary of Groundwater Pumping under the Proposed Action

Under the Proposed Action, it appears that Intrepid may be able to get the water needed for the project as injectate from the Magenta and Culebra members of the Rustler Formation. Most of this Rustler water would come from the Rustler North area in Clayton Basin. In order for Intrepid to obtain 2,000 gpm, the fracture system in the Section 2 area would have to be well integrated and capable of yielding 670 gpm for at least 7 years. If this is not the case, then Intrepid would have only around 1,500 to 1,600 gpm for injectate water during the first 7 years of mine life (Phase I). **Table 4.3-2** summarizes the results of the models to quantify potential impacts.

The potential for decreased groundwater supply to springs, seeps, and Nash Draw would be greatest if the conditions characterized in the Rustler Enhanced groundwater model exist, but the impacts also would be significant under the conditions characterized by the Rustler Preferred groundwater model. It is possible that the reduced groundwater flows from Nash Draw caused by project pumping may significantly reduce inflow into the Pecos River. However, due to the distance between Nash Draw and the Pecos River, the climate, and dry soil conditions, it is impossible to determine whether the river flows would be reduced and by how much.

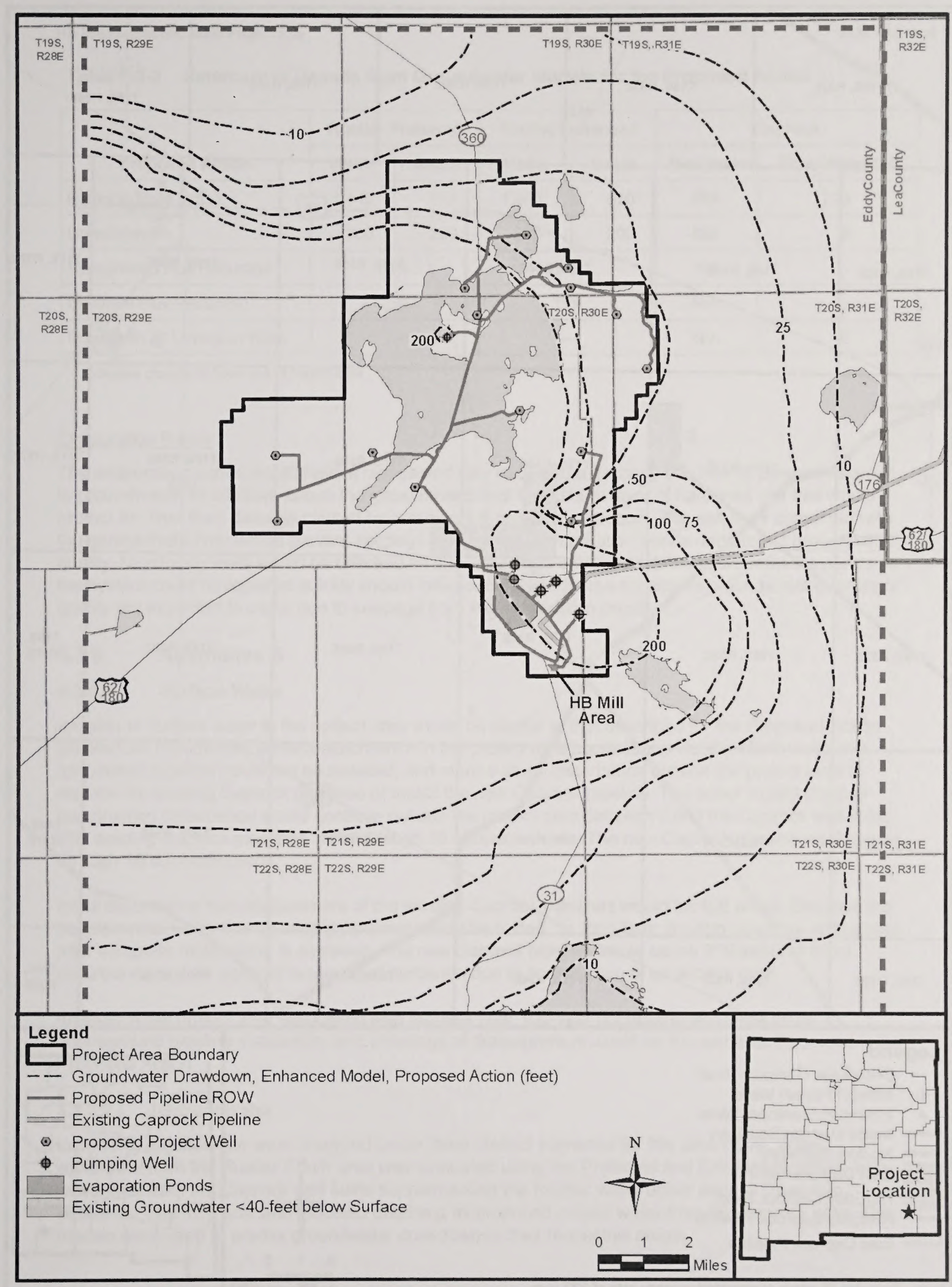
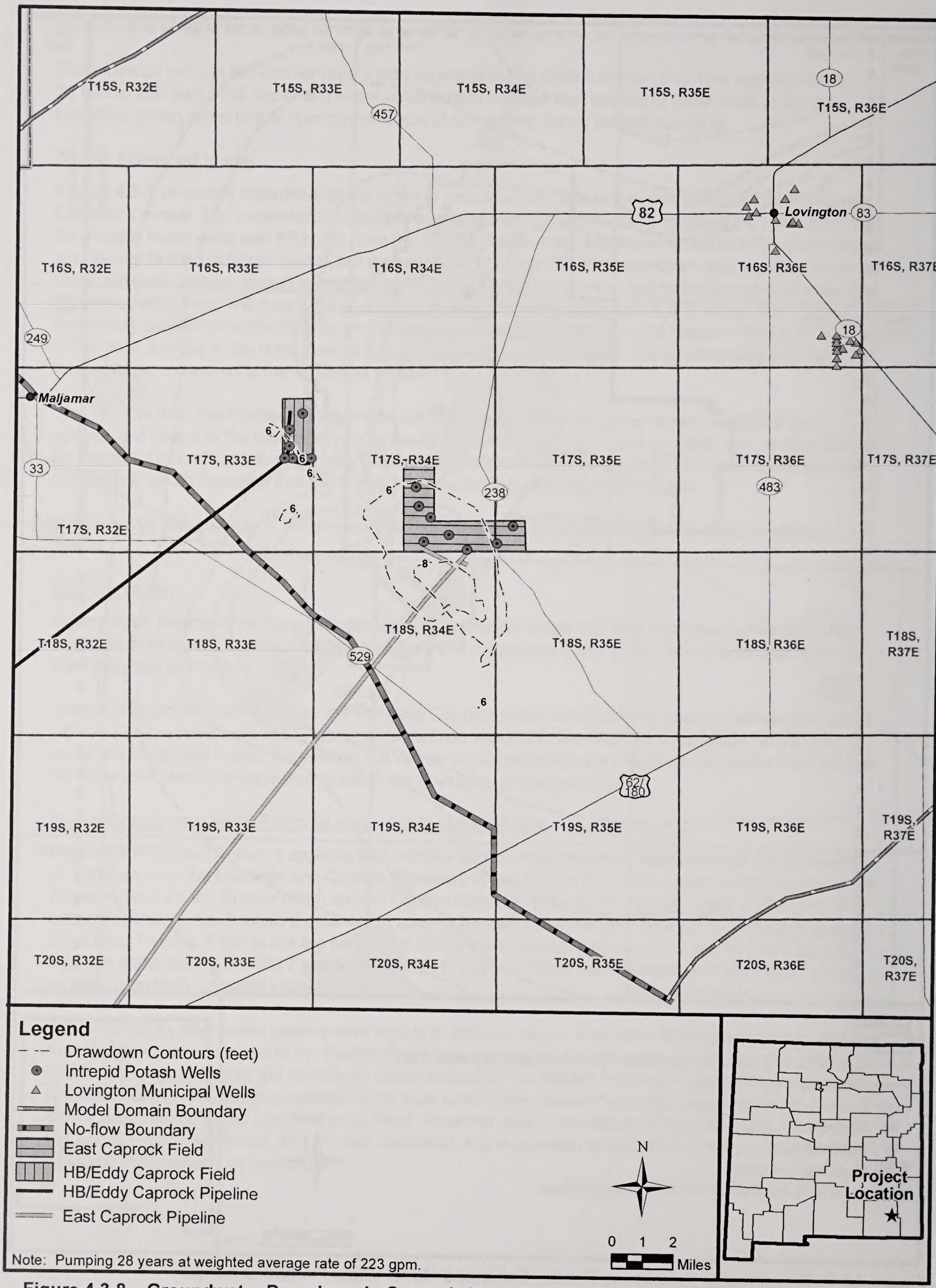


Figure 4.3-7. Groundwater Drawdown, Rustler Enhanced Model under Proposed Action



Note: Pumping 28 years at weighted average rate of 223 gpm.

Figure 4.3-8 Groundwater Drawdown in Caprock Area, Proposed Action (Time-weighted Average)

Table 4.3-2 Summary of Results from Groundwater Models for the Proposed Action

	Rustler Preferred		Rustler Enhanced		Caprock	
Proposed Action	North	South	North	South	Maximum	Time-Weighted
Pumping Rate (gpm)	1,440	177	1,440	670	N/A	223
Drawdown (ft)	200	200	200	200	N/A	8
Spring/Seep Flux Reduction	61%		64%		N/A	—
Southern Flux Reduction[1]	25%		35%		N/A	—
Drawdown @ Lovington Wells	—		—		N/A	0

[1] Indicates change in flows out of Nash Draw.

Evaporation Ponds

The evaporation ponds would have a compacted clay base and a geosynthetic liner to prevent seepage to groundwater. In addition, above the geosynthetic liner would be a layer of hardened salt that would protect the liner from damage caused by scraping the precipitated potash. The salt layer combined with the geosynthetic liner would prevent seepage loss from the evaporation ponds and protect groundwater quality. Monitoring wells would be checked on a regular basis and would detect leaks from the ponds so the system could be repaired quickly should leaks occur. No adverse impacts to groundwater quantity or quality are expected to occur due to seepage from the evaporation ponds.

4.3.6 Alternative B

4.3.6.1 Surface Water

Impacts to surface water in the project area would be similar to that described for the Proposed Action. Differences include less surface disturbance in the project area because the Rustler North wells and associated pipeline would not be installed, and more surface disturbance outside the project area to replace the existing Caprock pipelines or install the new Caprock pipeline. The water supply pipeline construction disturbance would continue outside the project area between it and the Caprock well fields. The existing Caprock pipelines cross through 16 subwatersheds. The new Caprock pipeline would cross through 10 subwatersheds.

Initial disturbance from replacement of the existing Caprock pipelines would be 400 acres. Because the supplemental water source supply pipelines would be buried, no long-term impacts would be anticipated after complete reclamation is achieved. The new Caprock pipeline would cause 279 acres of initial disturbance and 84 acres of long-term disturbance due to construction of an access road.

Impacts in the project area associated with facilities near 100-year floodplains and alkali lakes, aboveground pipeline installation, and crossings of drainageways would be the same as those under the Proposed Action.

4.3.6.2 Groundwater

Impacts to groundwater were analyzed under three distinct scenarios for this alternative. Water withdrawal from the Rustler South area was evaluated using the Preferred and Enhanced models, with withdrawal from the Caprock well fields supplementing the Rustler water under each of these two scenarios. The third scenario modeled obtaining all proposed project water from the Caprock area. The models were used to predict groundwater drawdown in their respective areas.

Rustler Preferred Model

Figure 4.3-9 depicts contours of projected drawdown of the existing groundwater surface that was predicted by the Rustler Preferred model. The maximum sustainable pumping rate under this scenario would be 177 gpm from the Rustler South wells, with no pumping from the Rustler North wells. The results indicate that maximum drawdown in the project area would occur in the area surrounding the South Rustler wells and would exceed 200 feet of drawdown below the existing groundwater elevations in the area. The total area of 200-foot drawdown is approximately 1,450 acres. The 10-foot drawdown contour extends beyond the project area boundary approximately 5.5 miles to the south, 3.5 miles to the east, crosses the middle of Clayton Basin to the north, and to the no-flow boundary in the west.

The impacts from the Rustler Preferred model under this scenario indicate that modeled groundwater contributions to springs and seeps in the calibrated model would decrease from 3,014 gpm to 2,790 gpm, a reduction of 7 percent. Groundwater flow to Nash Draw would decrease from 306 gpm to 272 gpm, a reduction of 11 percent, which indicates that there may be reduced flows into the Pecos River.

Water use impacts in the Rustler area would be less than under the Proposed Action because the Rustler North area would not be pumped. Under this alternative and scenario, all the domestic and livestock wells of record in the area would fall outside the 10-foot drawdown contour.

Caprock Model (and Rustler Preferred)

Maximum drawdown impacts are displayed on **Figure 4.3-10** and reflect the projected drawdown of the current groundwater levels during maximum pumping of the Caprock well fields, a situation that would occur to achieve the stated maximum pumping rate of 2,000 gpm for the first 7 years of the project (Phase I). **Figure 4.3-11** displays the maximum drawdown under the time-weighted average scenario, Maximum drawdown from this model was 54 feet in the area directly south of the East Caprock well field, with approximately 12 feet of drawdown at the Lovington municipal well field approximately 11 miles to the northeast.

The time-weighted drawdown, displayed on **Figure 4.3-11**, reflects the drawdown that would occur over the life of the project (28 years). The maximum drawdown from current groundwater levels would be 24 feet over the life of the project. The 10-foot drawdown contour would extend to within approximately 5 miles from the Lovington municipal wells.

Groundwater pumping under this alternative would include a 100-foot or greater maximum drawdown at all 373 wells identified within three miles of the Caprock well fields during Year 7 of the Project (Phase I). The Lovington municipal wells would experience a maximum drawdown of 12 feet at that time, with a sustained drawdown of less than 10 feet for the life of the project. This amount of drawdown would not adversely affect the other Caprock wells in this area.

Rustler Enhanced Model

Figure 4.3-12 depicts projected drawdown of the existing groundwater surface that was predicted by the Rustler Enhanced model under Alternative B. The maximum sustainable pumping rate under this scenario would be 670 gpm from the Rustler South wells. Maximum drawdown from this model was similar to the Preferred model, but the areal extent of the 200-foot drawdown was significantly larger (approximately 3 times larger) in the Rustler South area due to the elevated conductivities and higher pumping rate assumed. The total area of 200-foot drawdown is approximately 4,750 acres. The 10-foot drawdown contour extends from the project area boundary approximately 6 miles to the south, 4 miles to the east, through the southern side of the project area to the north, and to the no-flow boundary in the west. These distances are slightly further when compared to the Preferred model. The impacts from the

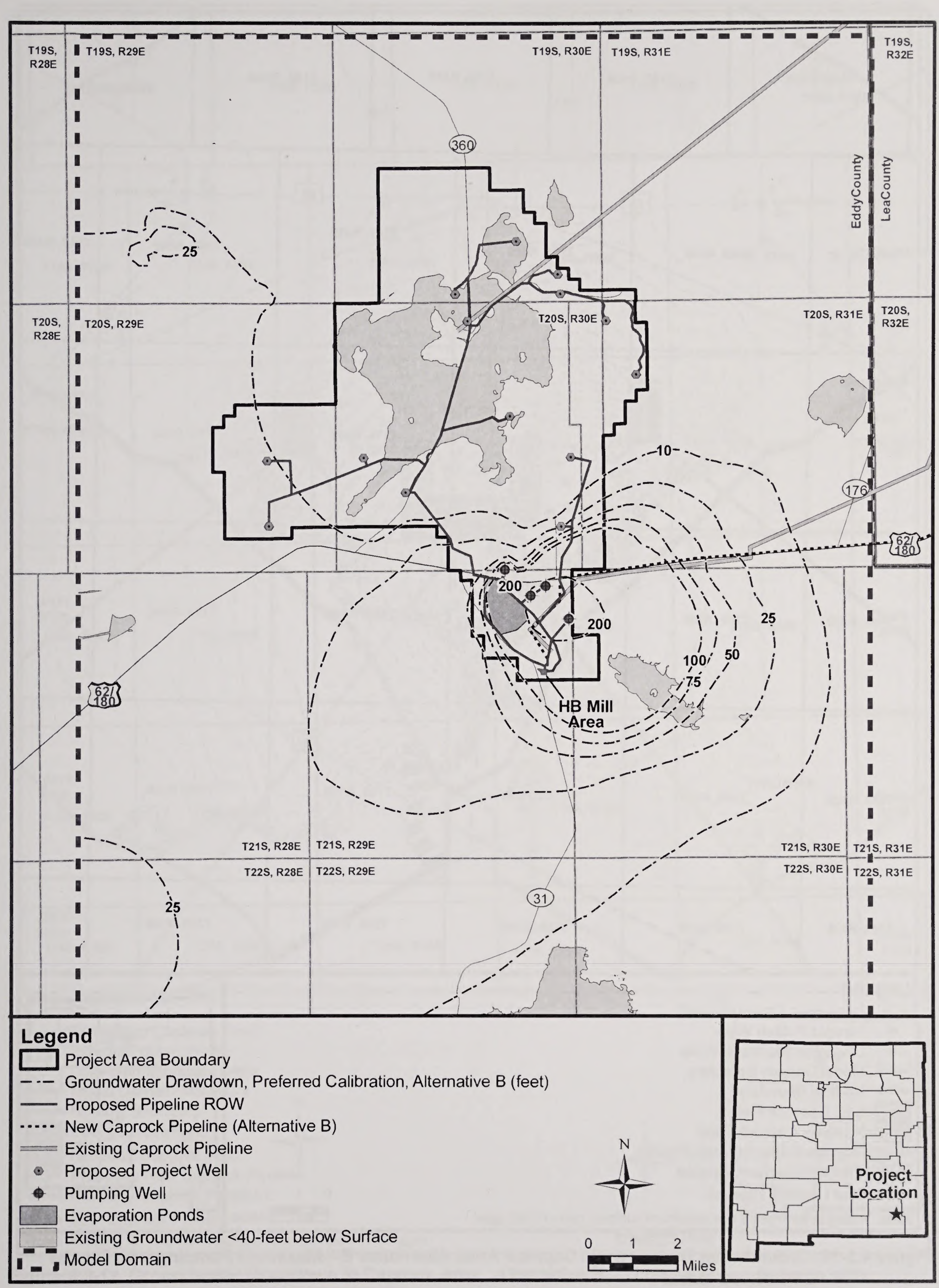
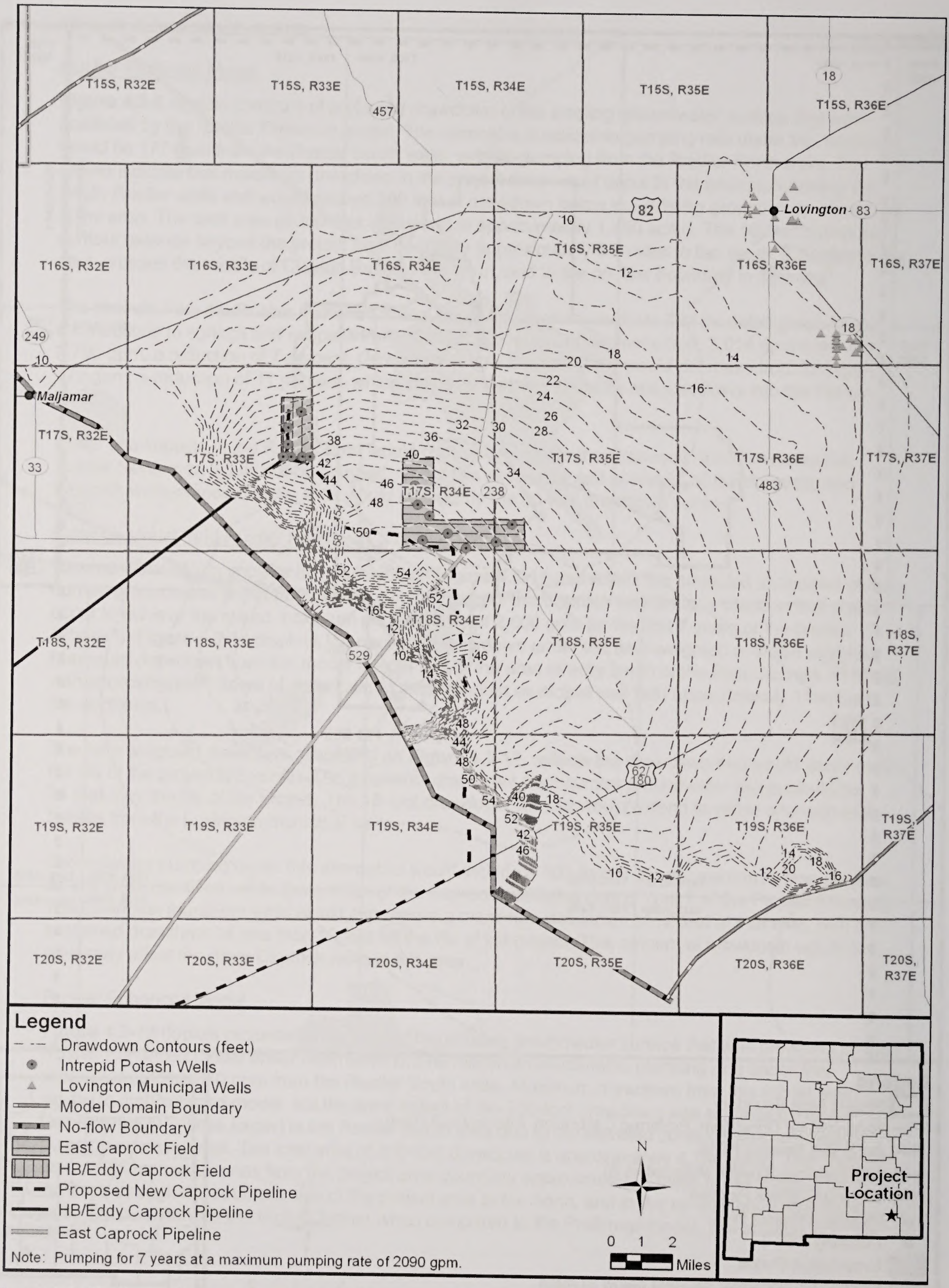


Figure 4.3-9 Groundwater Drawdown, Rustler Preferred Model under Alternative B



Note: Pumping for 7 years at a maximum pumping rate of 2090 gpm.

Figure 4.3-10. Groundwater Drawdown in Caprock Area, Alternative B—Maximum Pumping with Rustler Preferred Model

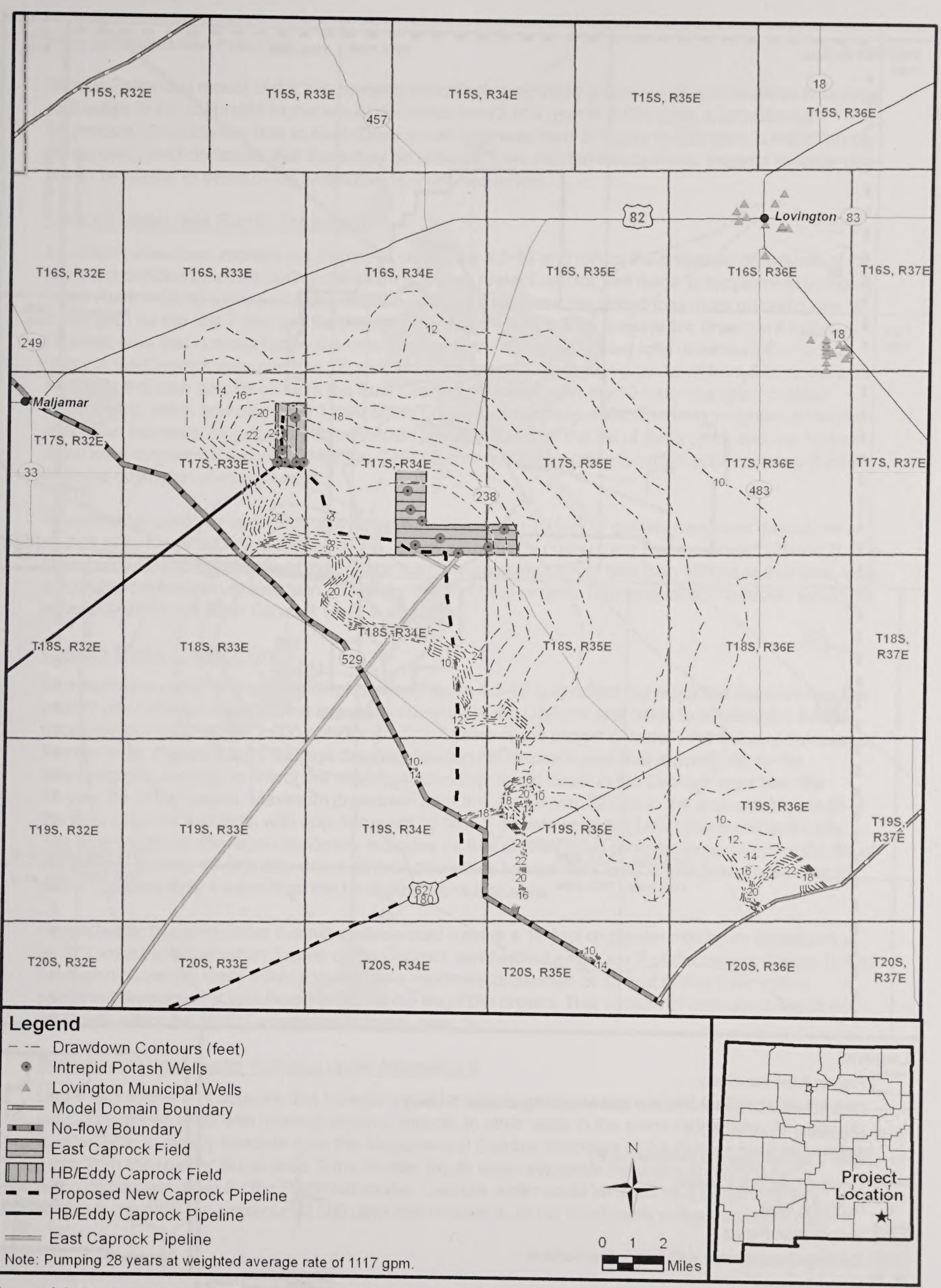


Figure 4.3-11. Groundwater Drawdown in Caprock Area, Alternative B—Time-weighted Average with Rustler Preferred Model

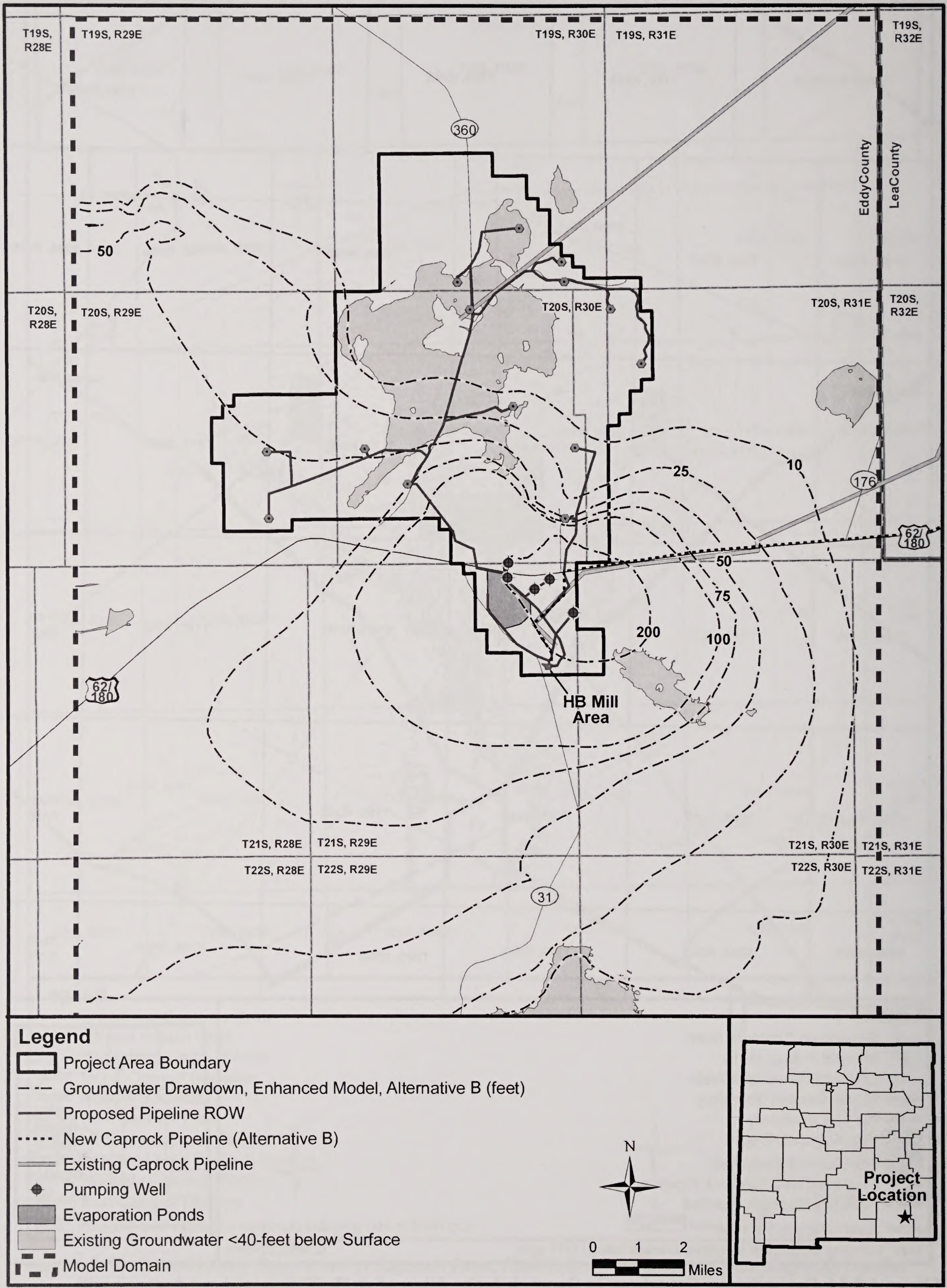


Figure 4.3-12 Groundwater Drawdown, Rustler Enhanced Model under Alternative B

Rustler Enhanced model under this scenario indicate that modeled groundwater contributions to springs and seeps in the calibrated model would decrease from 3,014 gpm to 2,070 gpm, a reduction of 31 percent. Groundwater flow to Nash Draw would decrease from 306 gpm to 228 gpm, a reduction of 25 percent, which indicates that there may be reduced flows into the Pecos River. Impacts to water use would be similar to those of the Alternative B, Preferred model.

Caprock Model (and Rustler Enhanced)

Maximum drawdown impacts are displayed on **Figure 4.3-13** and reflect the projected drawdown of the current groundwater levels during maximum pumping of the Caprock well fields to supplement pumping in the Rustler South area, a situation that would occur to achieve the stated maximum pumping rate of 2,000 gpm for the first 7 years of the project (Phase I). **Figure 4.3-14** displays the drawdown in the Caprock area that is predicted by the time-weighted average to reflect the total drawdown that would occur in the Caprock area over the 28-year life of the project. Maximum drawdown from this model was 46 feet in the area directly south of the East Caprock well field, with the 10-foot drawdown contour extending to within approximately 1 mile of the Lovington municipal wells. The time-weighted drawdown maximum indicates 20 feet of drawdown could be expected over the life of the project, and the 10-foot drawdown contour decreases toward the Caprock well fields, extending to within approximately 9 miles from the Lovington municipal wells.

Groundwater pumping under this alternative would include a 10 foot or greater maximum drawdown at all 373 wells identified within 3 miles of the Caprock well fields during Year 7 of the project (Phase I). The Lovington municipal wells would experience a maximum drawdown of less than 10 feet at that time, with a sustained drawdown of less than 10 feet for the life of the project. This amount of drawdown would not adversely affect the other Caprock wells in this area.

Caprock Model (Caprock Only)

Maximum drawdown impacts are displayed on **Figure 4.3-15** and reflect the projected drawdown of the current groundwater levels during maximum pumping of the Caprock well fields to achieve the stated maximum pumping rate of 2,000 gpm for the first 7 years of the project (Phase I) without any pumping of Rustler wells. **Figure 4.3-16** displays the drawdown in the Caprock area that is predicted by the time-weighted average to reflect the total drawdown that would occur in the Caprock area over the 28-year life of the project. Maximum drawdown from this model was 62 feet in the area directly south of the East Caprock well field, with approximately 13 feet of drawdown at the Lovington municipal wells. The time-weighted drawdown maximum indicates 34 feet of drawdown could be expected over the life of the project, and the 10-foot drawdown contour decreases toward the Caprock well fields, extending to within approximately 4 miles from the Lovington municipal wells.

Groundwater pumping under this alternative would include a 10-foot or greater maximum drawdown at all 373 wells identified within 3 miles of the Caprock well fields during Year 7 of the project (Phase I). The Lovington municipal wells would experience a maximum drawdown of 13 feet at that time, with a sustained drawdown of less than 10 feet for the life of the project. This amount of drawdown would not adversely affect the other Caprock wells in this area.

Summary of Groundwater Pumping under Alternative B

Under Alternative B, it appears that Intrepid would be able to get the water needed for the project from the Caprock well fields with minimal adverse impacts to other wells in the surrounding area. The use of Rustler wells to supply injectate from the Magenta and Culebra members of the Rustler Formation would come from the Rustler South area. If the Rustler South area only yields the water according to the pumping rate assumed for the Preferred model, Caprock water could be used as a supplementary source to maintain the maximum 2,000 gpm rate needed to fill the flood pools at the maximum rate

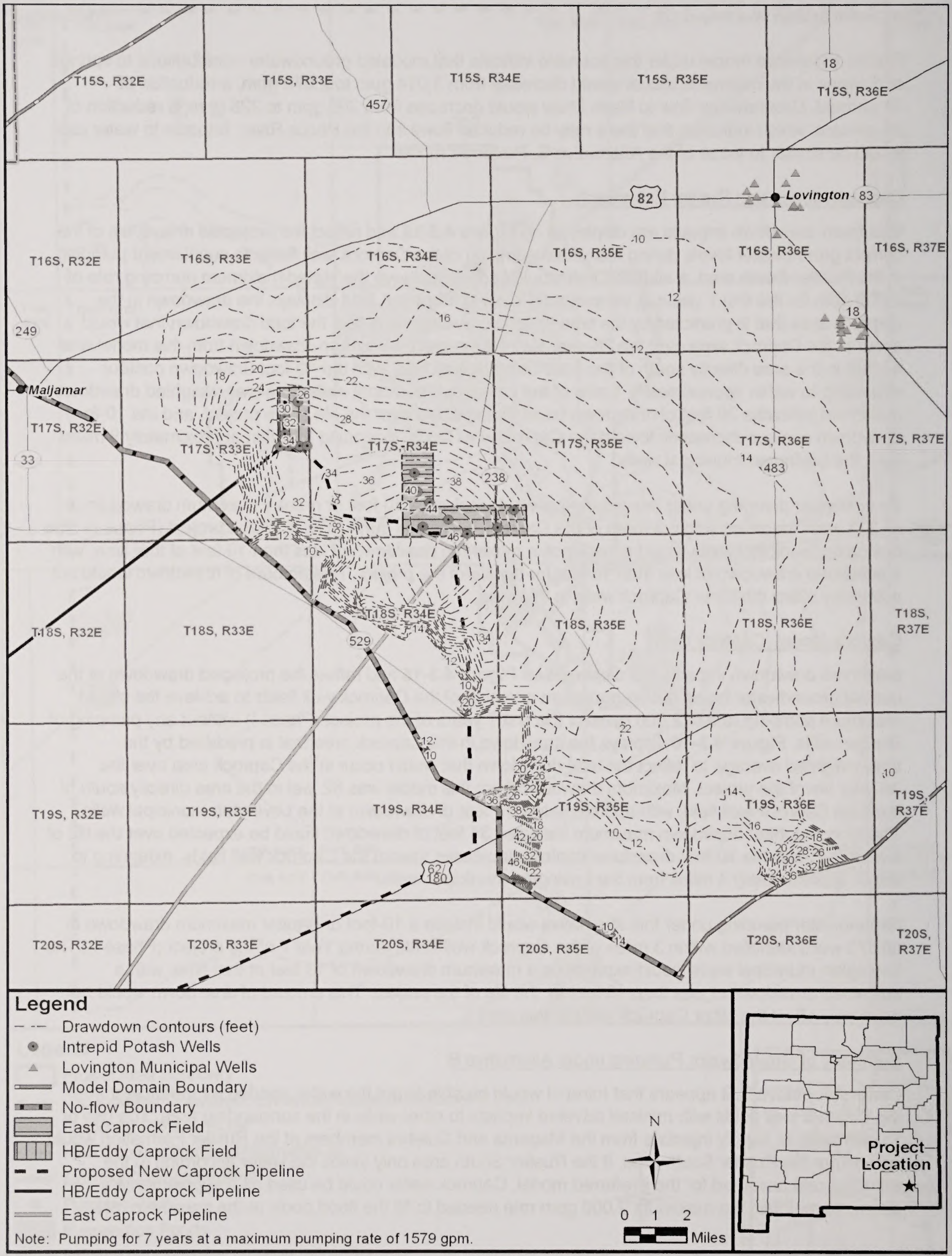
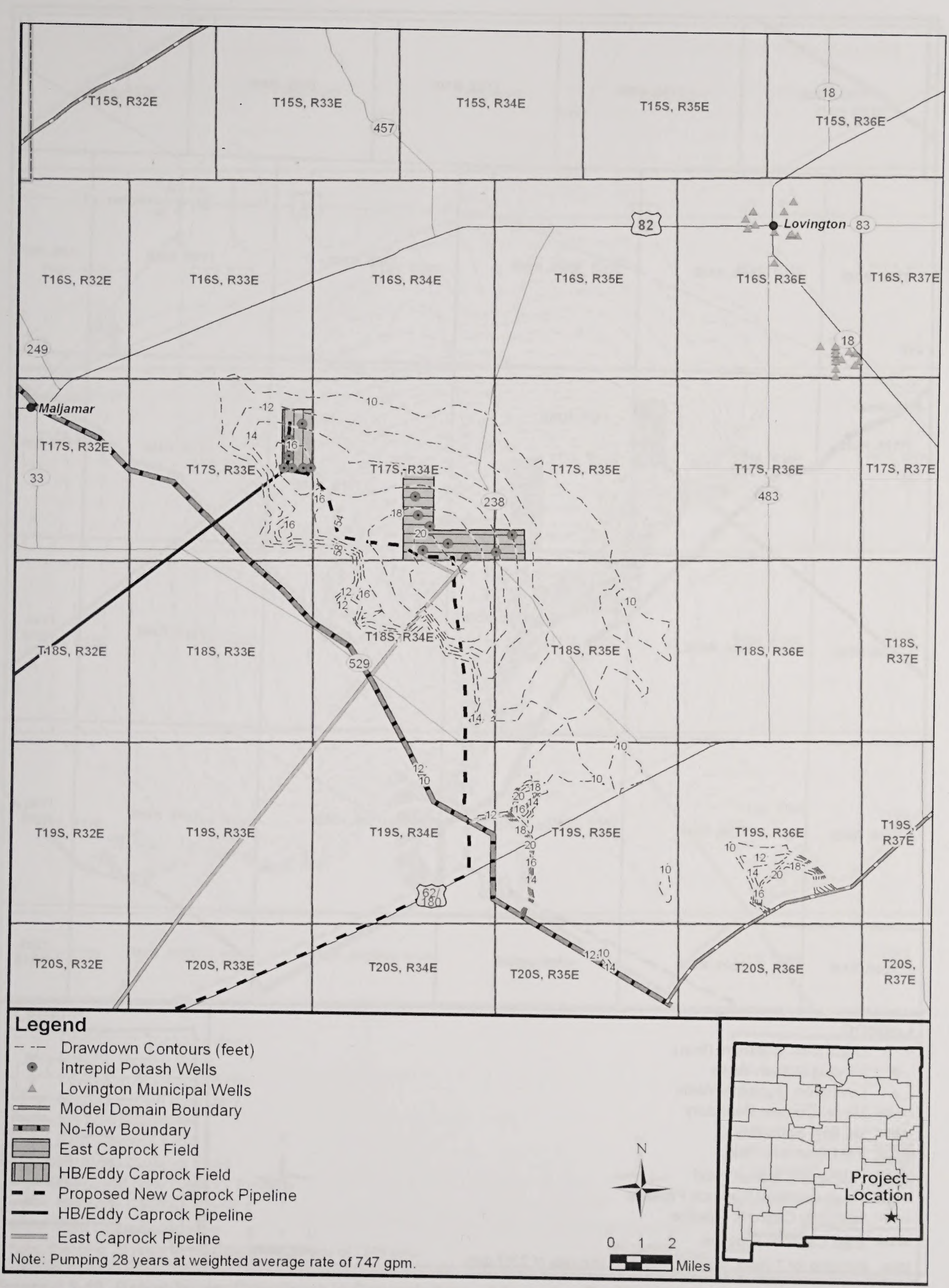
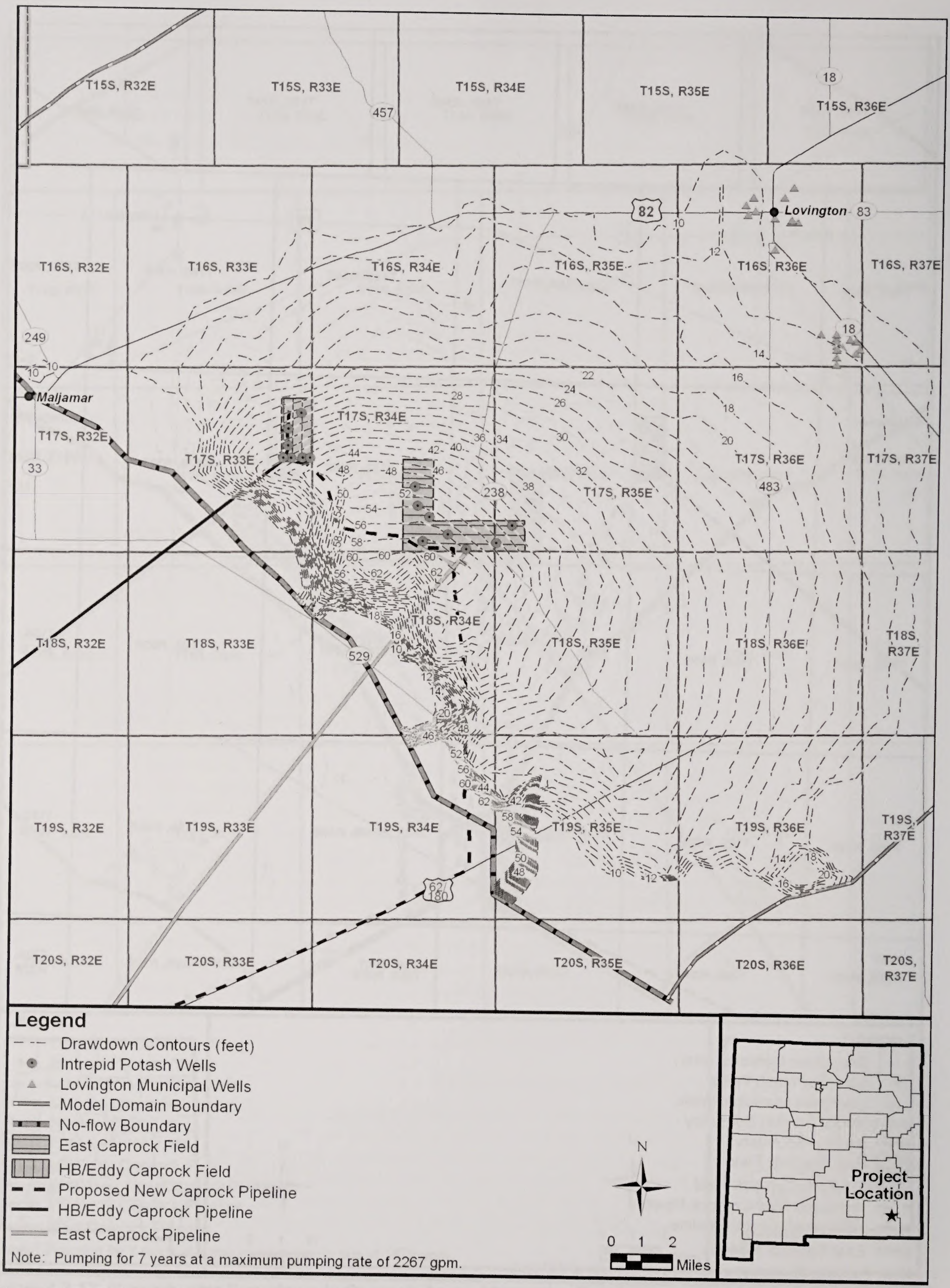


Figure 4.3-13. Groundwater Drawdown in Caprock Area, Alternative B—Maximum Pumping with Rustler Enhanced Model



Note: Pumping 28 years at weighted average rate of 747 gpm.

Figure 4.3-14. Groundwater Drawdown in Caprock Area, Alternative B—Time-weighted Average with Rustler Enhanced Model



Note: Pumping for 7 years at a maximum pumping rate of 2267 gpm.

Figure 4.3-15. Groundwater Drawdown in Caprock Area, Alternative B—Maximum Pumping, Pumping Caprock Only

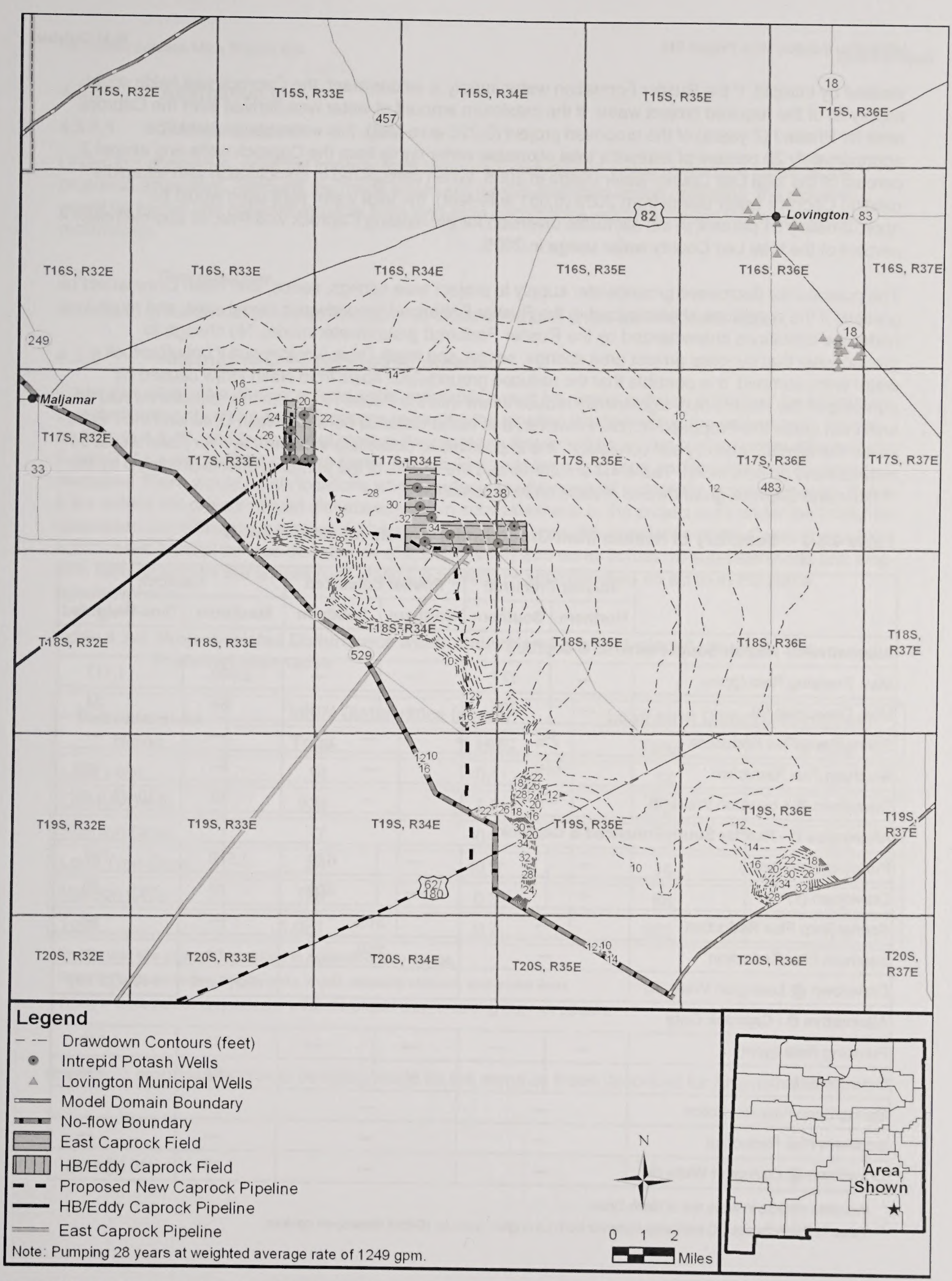


Figure 4.3-16. Groundwater Drawdown in Caprock Area, Alternative B—Time-weighted Average, Pumping Caprock Only

desired by Intrepid. If the Rustler Formation water supply is inconsistent, the Caprock well fields could supply all of the required project water. If the maximum amount of water was derived from the Caprock area for Phase I (7 years) of the proposed project (3,226 acre-feet), this water usage would be approximately 20 percent of Intrepid's total allowable water rights from the Caprock wells and almost 2 percent of the total Lea County water usage in 2005. When considered in combination with Intrepid's existing Caprock water usage from 2009 (5,051 acre-feet), the total water right used would be approximately 51 percent of the allowable diversion for the existing Caprock well field, or approximately 4 percent of the total Lea County water usage in 2005.

The potential for decreased groundwater supply to project area springs, seeps, and Nash Draw would be greatest if the conditions characterized in the Rustler Enhanced groundwater model exist, and much less under the conditions characterized by the Rustler Preferred groundwater model. No change to groundwater that supplies project area springs, seeps, and Nash Draw would result if only Caprock water were pumped. It is possible that the reduced groundwater flows from Nash Draw caused by pumping of the Rustler may significantly reduce inflow into the Pecos River, but the reduction would be less than under the Proposed Action. However, due to the distance between Nash Draw and the Pecos River, the climate, and dry soil conditions, it is impossible to determine whether the river flows would be reduced and by how much. **Table 4.3-3** summarizes the results of the pumping effects predicted by the Rustler and Caprock groundwater models under Alternative B.

Table 4.3-3 Summary of Results from Groundwater Models for Alternative B

	Rustler Preferred		**Rustler Enhanced**		**Caprock**	
	Northern	**Southern**	**Northern**	**Southern**	**Maximum**	**Time-Weighted**
Alternative B - Rustler South Preferred & Caprock						
Max. Pumping Rate (gpm)	—	177	—	—	2,090	1,117
Max. Drawdown (ft)	—	200	—	—	54	24
Spring/Seep Flux Reduction	7%		—		—	—
Southern Flux Reduction	11%		—		—	—
Drawdown @ Lovington Wells (ft)[1]	—		—		12	<10 (@ 5 mi)
Alternative B - Rustler South Enhanced & Caprock						
Pumping Rate (gpm)	—	—	—	670	1,579	747
Drawdown (ft)	—	—	—	200	46	20
Spring/Seep Flux Reduction	—		31%		—	—
Southern Flux Reduction[1]	—		25%		—	—
Drawdown @ Lovington Wells (ft)[2]	—		—		<10 (1 mi)	<10 (@9 mi)
Alternative B - Caprock Only						
Pumping Rate (gpm)	—	—	—	—	2,267	1,249
Drawdown (ft)	—	—	—	—	62	34
Spring/Seep Flux Reduction	—		—		—	—
Southern Flux Reduction	—		—		—	—
Drawdown @ Lovington Wells (ft)[1]	—		—		13	<10 (@4 mi)

[1] Indicates change in flows out of Nash Draw.

[2] Value in Parentheses (X) indicates distance from Lovington wells to 10-foot drawdown contour.

4.3.7 Alternative C

4.3.7.1 Surface Water

Under this alternative, potential impacts from temporary disturbance would remain the same as the proposed alternative. Although the roads would still remain disturbed during operation, the pipelines would be buried and potential impacts from long-term disturbance would decrease following surface reclamation.

4.3.7.2 Groundwater

Impacts to groundwater would be the same as those described under the Proposed Action.

4.3.8 Alternative D—Preferred Alternative

Under this alternative, the impacts to water resources would be similar to those described for Alternative B, with the exception of a few differences regarding the pipeline location within the project area, shown on **Figure 4.3-17**, and the burial of most of the pipelines that would be on the surface under Alternatives A and B. As a result of the pipeline burial, potential impacts from long-term surface disturbance would decrease. There would be six locations where surface pipelines would potentially cross drainages. **Table 4.3-4** details the project-related disturbance within subwatersheds in the project area under the Preferred Alternative. In addition to surface disturbance in the project area, the installation of the Caprock pipeline would result in initial surface disturbance of approximately 285 acres across 10 subwatersheds and long-term bare ground for the access road along the pipeline of approximately 85 acres in the same subwatersheds.

Table 4.3-4 Project-related Disturbance within Subwatersheds in Project Area under the Preferred Alternative

Subwatershed Name	Initial Disturbance (acres)		Long-term Disturbance (acres)	
	Total	% HUC	Total	% HUC
Little Lake	14	<0.1	12	<0.1
Clayton Basin	906	1.7	772	1.5
Scanlon Draw	7	<0.1	1	<0.1
Lone Tree Draw	24	<0.1	14	<0.1
Maroon Cliffs	120	0.3	68	0.2
Total	1,071	0.7	882	0.7

Project well site acreage is included in pipeline ROW acreage.

ROW includes project pipelines, wells, roads, lift/pump stations, and power lines.

Totals in table include only acreage within the project area, excluding Caprock pipeline.

Impacts to groundwater due to pumping would be the same as those described for Alternative B.

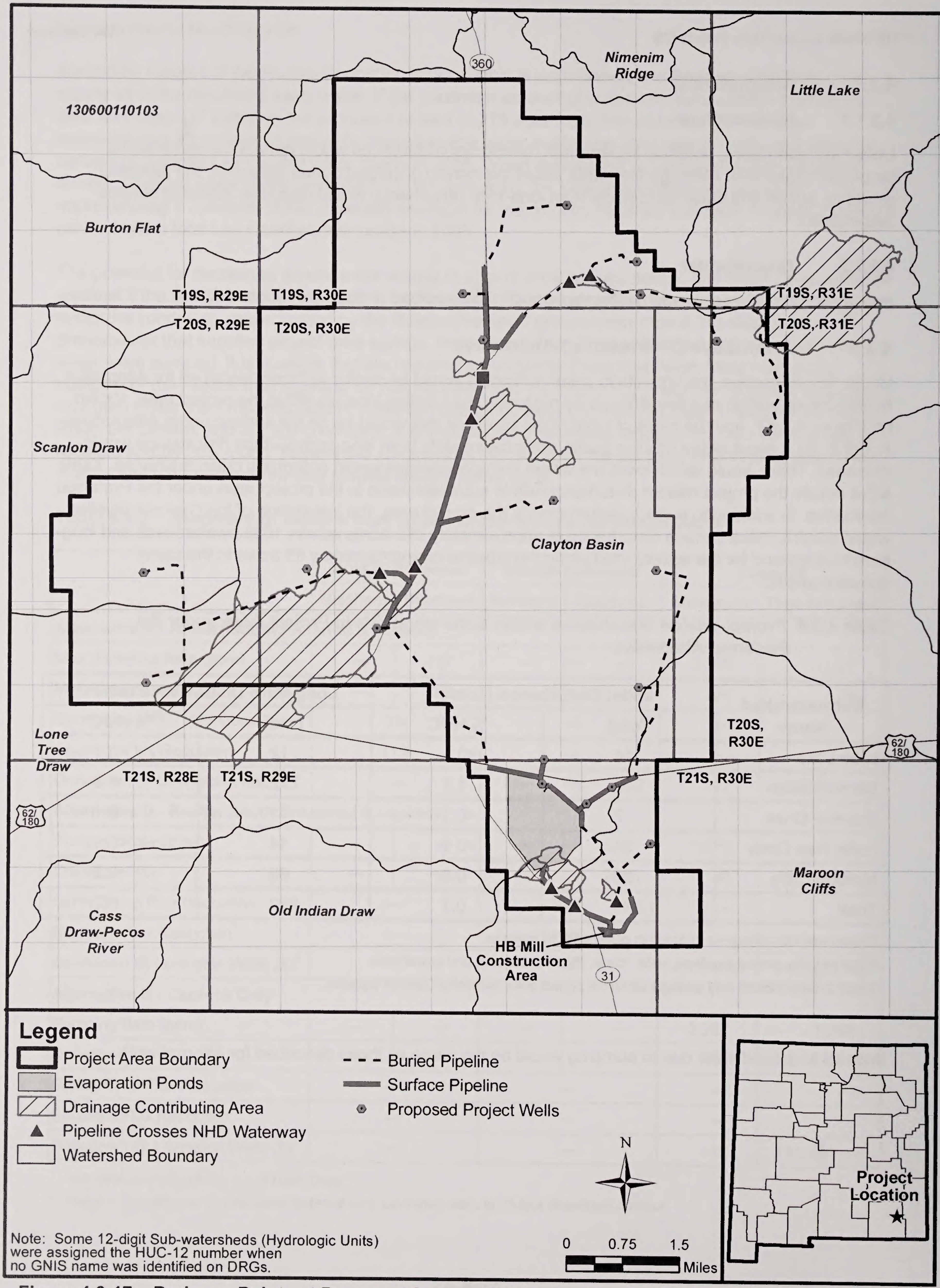


Figure 4.3-17 Drainage Points at Proposed Surface Pipelines under Preferred Alternative

4.3.9 Mitigation Measures

Pipeline construction would comply with BLM environmental protection measures (**Table 2-9**) and associated culvert measures for road construction. Recommended additional mitigation measures include the following.

- Where surface pipelines cross existing drainages or intersect points with large contributing drainage areas, the pipelines should be buried below potential scour depth and stabilized with rock to minimize the potential for erosion.
- If the Rustler North area wells are pumped, the water extracted should be treated to remove the lead before it is combined with other water sources and used for injectate in the flood pools.
- A mitigation plan to minimize impacts to groundwater resources should be developed to identify potential measures to reduce groundwater drawdown such as water conservation improvements.

4.3.10 Summary of Impacts

4.3.10.1 Surface Water

Table 4.3-5 summarizes the acreage disturbed that may affect surface water bodies.

Table 4.3-5 Summary of Impacts to Surface Water Resources

Disturbance	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Construction	None	1,022 acres	1,435 acres	1,022 acres	1,331 acres
Operation	None	829 acres	914 acres	829 acres	961 acres

4.3.10.2 Groundwater

The Proposed Action would draw down groundwater potentiometric surfaces in the Rustler North and South areas of the project area by approximately 200 feet. Groundwater contributions to seeps, springs, and underflow to Nash Draw would decrease from current conditions due to project-related drawdown. The Caprock Area would experience 8 feet of drawdown over the life of the project. No drawdown would occur at the Lovington municipal wells. Pumping under the Proposed Action scenarios would have the greatest potential impact to springs, seeps, and Nash Draw and possibly to the Pecos River.

Under Alternative B, drawdown in the Rustler Area would be less than under the Proposed Action, while drawdown in the Caprock area would be greater. Groundwater contributions to seeps, springs, and underflow to Nash Draw would decrease from current conditions but the depletion would be less than under the Proposed Action. Increased drawdown in the Caprock area also would slightly increase drawdown at the Lovington municipal wells.

Under Alternative C, groundwater impacts would be the same as those of the Proposed Action.

Under the Preferred Alternative, groundwater impacts would be the same as those of Alternative B.

Table 4.3-6 summarizes the impacts to groundwater under all alternatives.

Table 4.3-6 Summary of Impacts to Groundwater Resources Under All Alternatives

	No Action	Proposed Action	Alternative B	Alternative C	Preferred Alternative
Pumping Rate	None	1,884 gpm to 2,267 gpm	2,267 gpm	1,884 gpm to 2,267 gpm	2,267 gpm
Maximum Rustler Area Drawdown	None	200 feet	200 feet	200 feet	200 feet
Seep/Spring Contribution Reduction	None	61% to 64%	7% to 31%	61% to 64%	7% to 31%
Nash Draw Contribution Reduction	None	25% to 35%	11% to 25%	25% to 35%	11% to 25%
Maximum Caprock Area Drawdown	None	8 feet	46 feet to 52 feet	8 feet	46 feet to 52 feet
Time-weighted Caprock Area Drawdown	None	8 feet	20 feet to 34 feet	8 feet	20 feet to 34 feet
Maximum Lovington Municipal Wells Drawdown	None	None	13 feet to less than 10 feet	None	13 feet to less than 10 feet
Time-weighted Lovington Municipal Wells Drawdown	None	None	less than 10 feet	None	less than 10 feet

4.4 Soils

The following impact analysis focuses on soil resources that may be affected by construction and operation of the proposed project. This section includes an overview of scoping issues identified for soil resources, impact assessment assumptions and methodologies, and proposed additional mitigation measures, as applicable, that would minimize or mitigate potential significant impacts.

4.4.1 Issues

Issues related to soil resources as identified during the scoping process include the following:

- Successful reclamation of soils is important to maintain productivity and stability.
- Concern for possible soil contamination associated with potential spills of salt brine thereby affecting reclamation potential.

4.4.2 Method of Analysis

Potential impacts to soil resources were investigated by examining the soil types, their extent, and their physical and chemical characteristics in relation to the locations of surface disturbance under each alternative. Using GIS, the SSURGO spatial data (NRCS 2008a) was overlaid with the locations of proposed ROWs and other facilities to identify the soil map units that would be disturbed. The tabular soil database was used to identify the acreage and locations of soils that would be disturbed under each alternative and to summarize selected limitations of the soil map units as described below.

- The acreage of soils with severe hazards and limitations was calculated to quantify the amount of aggressive environmental protection measures and monitoring.
- The soil characteristics and acreage of soils initially disturbed by construction were identified because these areas would be likely to have accelerated erosion in the short-term, until interim reclamation is implemented.
- The soil characteristics and acreage of soils to be left bare or in an altered state for the life of the project (such as surfaced roads and areas around well pads) were identified as areas with the potential for erosion if unstabilized.

4.4.3 Assumptions

Analysis was based on the following assumptions:

- Direct effects on soils would occur primarily due to the physical disturbance of the upper soil layers and the disruption of soil biological processes, caused by activities that alter the natural soil layers or result in accelerated erosion, increased soil compaction, loss of protective vegetation, and loss of soil productivity.
- Indirect effects on soils include reduced surface water infiltration, an associated increase in surface water runoff, and poor plant growth or seed germination.
- Bare soil (without vegetation or other surface cover) with a surface layer that has been altered from its natural condition is more susceptible to accelerated wind and water erosion than undisturbed soil.
- Any surface disturbance has the potential to degrade soil quality and productivity because it damages the biological soil crust and exposes the bare soil to the erosive forces of wind and water until revegetation or other ground cover is established.
- Erosion from disturbed areas would be minimal once vegetation is reestablished. Successful establishment of vegetation generally takes a minimum of 3 years, depending on soil and precipitation, and requires monitoring during this time.
- Surface disturbance from construction would modify soils by disrupting soil stability, changing vegetative cover that can reduce nutrient recycling, damaging biological crusts, decreasing productivity, and increasing compaction.
- When surface disturbance occurs on highly erodible soils, the potential for accelerated erosion is greater than on less erodible soils. Sensitive soils would incur greater adverse impacts from surface-disturbing activities than non-sensitive soils. Sensitive soils include those that are highly erodible, have a high pH, high salinity or sodicity, have a high clay content, or have a low reclamation potential.
- The New Mexico Standards for Public Land Health (BLM 2001) provide minimum standards for vegetation health, vigor, soil cover, and erosion rates that apply to all BLM administered activities.
- The risk of BMP failure is greater on highly erodible soils. To be effective on highly erodible soils, more extensive BMPs and more aggressive maintenance techniques than those commonly used are often required.
- Applicant-committed measures and standard BMPs would be successfully implemented, monitored, and maintained.
- Erosion on the landscape may contribute to sediment yield if it results in sediment delivery to the surface water drainage system of arroyos and streams. Only a fraction of the total amount of soil erosion on the landscape actually reaches surface water channels.

- Operating motorized vehicles on moist soils, especially heavy equipment, is likely to cause compaction of the surface layer, which may increase runoff, decrease infiltration and aeration, and reduce soil productivity by making it more difficult for plant roots to establish or obtain soil moisture and nutrients.

The thresholds for impact analysis and significance include:

- The significance of the effects on soils is related to the areal extent of the impacts and the length of time necessary for the soils to recover following surface disturbance.
- The significance of the direct effects on soils from the surface-disturbing activities (soil displacement, compaction, erosion, loss of productivity) can be assessed in relation to the extent of indirect effects on other resources. For example, if surface-disturbing activities cause erosion that leaves the construction site and enters waterways that already have identified impairment due to high volumes of sediment, turbidity, and excessive stream bottom deposits, a small increase in sediment entering this water system may be considered significant. If removal or compaction of topsoil damages soil-protecting vegetative cover and limits the success of revegetation to stabilize soils, accelerated erosion would result that would reduce feed and cover for wildlife, forage for livestock, and downstream water quality.

4.4.4 No Action Alternative

Under the No Action Alternative, the proposed project would not be authorized by the BLM and would not be developed. Project-related impacts to soils from construction and operation would not occur. Natural and human-caused effects of erosion, agriculture, fire, recreation, oil and gas development, mining, and grazing would continue to affect soil resources at present levels in the project area.

4.4.5 Alternative A—Proposed Action

The Proposed Action would result in approximately 1,022 acres of initial soil disturbance. **Table 4.4-1** provides the acres of disturbance for Alternative A associated with specific limitations as described in Section 3.4.

Surface disturbance associated with construction of project roads, the HB mill, wells, ponds, pipelines, power lines, and other associated facilities would impact soil resources to varying degrees. The most notable disturbance to soils would occur on soils with severe limitations.

Grading and leveling would be required to construct the HB mill, wells, and facilities, with the greatest level of effort required on sloping areas. During construction, the soil profiles would be mixed with a corresponding loss of soil structure. Some of the subsoils in the area are characterized as having high pH, salts, and sodium. Soil mixing could alter physical and chemical properties such as sodium content, alkalinity, organic matter, salinity, rock fragments, high carbonates, and high sand or clay content, which could have negative effect on soil productivity and alter revegetation potential and other reclamation work. Similarly, soil productivity and the potential for successful reclamation would decrease if spills of salt brine or dried salt precipitants were to occur. Topsoil would be stockpiled at well pads, where topsoil is available. Approximately 2 percent of the initial soil disturbance would occur on soils characterized as having poor topsoil suitability. In these areas, suitable topsoil may not be available to stockpile. Approximately 77 percent of the area initially disturbed within the project area would have poor potential for revegetation, requiring aggressive mitigation measures and monitoring to ensure successful reclamation.

Soils would be compacted as a result of the construction of the HB mill, project roads, and associated facilities with compaction maintained, at least in part, by continued vehicle and foot traffic as well as operational activities.

Table 4.4-1 Limitations of Soils Affected by Surface Disturbance under Alternative A

	Good				Fair				Poor				Not Rated			
	Initial Disturbance		Permanent Disturbance		Initial Disturbance		Permanent Disturbance		Initial Disturbance		Permanent Disturbance		Initial Disturbance		Permanent Disturbance	
Soil Limitation	**Acres/%**		**Acres/%**		**Acres/%**		**Acres/%**		**Acres/%**		**Acres/%**		**Acres/%**		**Acres/%**	
Wind Erosion	8	1%	4	0%	581	57%	496	48%	216	21%	159	16%	0	0%	0	0%
Water Erosion	840	82%	682	67%	0	0%	0	0%	0	0%	0	0%	42	4%	31	3%
Road Construction	435	42%	372	45%	192	19%	129	16%	178	17%	159	19%	78	8%	54	6%
Shallow Excavations	73	7%	46	6%	214	22%	180	22%	517	53%	433	52%	78	8%	54	6%
Potential for Revegetation	0	0%	0	0%	16	2%	8	1%	792	77%	653	79%	75	7%	52	6%
Topsoil Suitability	210	21%	155	15%	510	50%	452	44%	22	2%	12	1%	141	14%	93	9%

Note: Acres will not equal total amount disturbed because not all minor soil map unit components are characterized in the SSURGO database.

Source: NRCS 2008a.

The potential for erosion would increase through the loss of vegetation and biological crust cover as compared to an undisturbed state. Approximately 21 percent of the initial disturbance would occur on highly wind erodible soils, while long-term disturbance would occur on approximately 16 percent of the soils that are susceptible to wind erosion.

Biological soil crusts are considered an important component in dry arid ecosystems. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. In arid environments, biological soil crusts are essential for soil stability due to minimal vegetative growth and soil cover. Biological soil crusts are highly susceptible to disturbance, especially in sandy soils (Belnap and Gardner 1993). Recovery rates are generally slow, specifically for lichen and moss recovery, which can take 45 to 250 years, respectively (Belnap and Gillette 1997). Biological crusts would be damaged by vehicle traffic, clearing, grubbing, and excavation. The effect of the proposed construction and operations activities on biological soil crusts would be very long-term.

Pipelines would be constructed on the soil surface and buried at site-specific locations within the project area, such as at road crossings and every quarter mile for wildlife crossings. Steep slopes would be avoided for pipeline construction. Approximately 52 percent of initial disturbance would occur on soils with severe limitations associated with shallow excavations, so trenches must be stabilized if allowed to stand open or if workers must enter a trench.

Construction of roads, ponds, and pipelines would result in a removal of vegetation, interrupting nutrient cycling and altering soil productivity. Indirect effects related to the construction of new access roads may include increased erosion caused by concentrated surface water runoff, and disruption and interception of subsurface flow of water that could alter soil moisture regimes upslope and down slope from the road. Where the topography is relatively flat and grading occurs, disturbance would be limited to the upper subsurface soil horizons. As a result, subsurface soils would not be subject to profile mixing. Where cut and fill slopes occur, the soil profiles would be mixed with a corresponding loss of soil structure. Caliche surfacing would be applied to stabilize the road surface.

Traffic on roads during construction and operations would result in soil compaction. Soil compaction would considerably impact the upper profile subsoils immediately beneath the road surface but also would impact subsurface soils at a greater depth if fine textured soils are present. Soil compaction would result in a corresponding loss of infiltration, permeability, and soil aeration. Runoff and soil erosion would increase as a result of compaction. Erosion also would be minimized through the use of erosion control devices (e.g., silt fences, jute netting, hay bales, water bars, check dams, berms, shallow swales, mulches).

Within Section 2, T21S, R29E, three Xcel overhead power lines with ROWs totaling 3.4 miles, two New Mexico Gas underground gas lines (1.8 miles), and one AT&T fiber optic line (0.6 mile) would require relocation prior to construction of the evaporation ponds. The resulting impacts related to pipeline relocation would include possible soil mixing during trenching and a short-term reduction in soil productivity. Impacts associated with power line relocations would include disturbance to surface soils due to grading of the ROW and compaction due to construction vehicles. There would be a site-specific loss of soil resources at pole locations. Soil mixing could also result during grading activities and adjacent to pole locations if unsuitable subsoils are brought to the surface during auguring.

These impacts would begin immediately as the soils are subjected to grading and other construction activities and would move to a steady state as construction activities are completed and interim reclamation and operations begin. As disturbed areas are reclaimed and vegetation is re-established the potential for erosion and sedimentation would be reduced.

Indirect effects would include a possible reduction in hydric soils found at playas, seeps, and springs due to drawdown associated with the pumping of groundwater from the Rustler Formation. In addition, soils compacted by construction equipment or covered with impermeable materials, such as concrete or compacted caliche, would have indirect effects related to a decrease in surface water infiltration, an associated increase in surface water runoff, and poor plant growth or seed germination.

4.4.6 Alternative B

Alternative B would result in 1,435 acres of initial impacts to soil resources. Alternative B would result in more surface disturbance to soils than the other alternatives. Impacts associated with this alternative would be similar to Alternative A except the PCA wells and pipelines would not be constructed. Instead either the existing Caprock pipelines would be replaced, or a new Caprock pipeline would be constructed further south of the existing line. Impacts associated with the facilities in the project area as described in Alternative A would be the same for Alternative B. Excavation of the old Caprock pipeline ROWs would disturb previously disturbed soils, while construction of the new line would cause new soil disturbance along the pipeline ROW. All disturbed areas affected by the replacement of the existing Caprock line would be stabilized and revegetated. Although the new Caprock pipeline would be stabilized through revegetation, there would be long-term disturbance affecting 914 acres due to the maintenance of access roads, caliche pits, and ponds.

Table 4.4-2 provides the acres and percentage of soils disturbed under Alternative B associated with the specific limitations described in Section 3.4 for the project area and Caprock pipelines. In areas with poor topsoil suitability, suitable topsoil may not be available to stockpile. Disturbance on soils that have a poor potential for revegetation may require aggressive mitigation measures and monitoring to ensure successful reclamation. Soils with severe limitations associated with shallow excavations would require stabilization of trenches if allowed to stand open or if workers are required to enter a trench.

In general, the direct and indirect impacts to soils described for the Proposed Action also would apply under Alternative B, but on more acreage due to the proposed excavation associated with construction of the proposed or existing Caprock pipelines.

4.4.7 Alternative C

Alternative C would result in 1,022 acres of initial soil disturbance. Impacts associated with Alternative C would be similar to Alternative A except all of the pipelines would be buried. This would require excavation of the soils within the pipeline ROW. Excavation of soils within the pipeline ROW would modify the existing soil structure and infiltration rates. Soil horizons would be mixed during excavation and reapplication, which could lower soil productivity by diluting the physical, biological, and chemical properties of the topsoil with less productive subsoil. Segregation of topsoil helps to mitigate these effects. There would be less long-term bare ground and no surface pipelines associated with Alternative C, but all other aspects of the implementing the project would be the same as the Proposed Action.

4.4.8 Alternative D—Preferred Alternative

The Preferred Alternative would result in 1,331 acres of initial surface disturbance, more soil disturbance than Alternatives A, B, or C. Topsoil would be stockpile, revegetated, and not be disturbed until final reclamation, which would improve reclamation success in the long term. **Table 4.4-3** provides the acres of disturbance for the Preferred Alternative associated with the specific soil limitations described in Section 3.4.

Table 4.4-2 Limitations of Soils Affected by Surface Disturbance under Alternative B

Soil Limitation	Good				Fair				Poor				Not Rated			
	Initial Disturbance		Perm Disturbance		Initial Disturbance		Perm Disturbance		Initial Disturbance		Perm Disturbance		Initial Disturbance		Perm Disturbance	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
With Proposed New Pipeline																
Wind Erosion	8	1%	4	0%	700	49%	534	58%	320	22%	192	21%	2	0%	52	6%
Water Erosion	1,071	75%	754	83%	-	0%	-	0%	-	0%	-	0%	4	0%	1	0%
Road Construction	465	32%	475	52%	206	14%	164	18%	179	12%	199	22%	78	5%	64	7%
Shallow Excavations	80	6%	60	7%	265	18%	242	26%	692	48%	595	65%	78	5%	64	7%
Potential for Revegetation	-	0%	-	0%	19	1%	11	1%	1,021	71%	888	97%	76	5%	62	7%
Topsoil Suitability	249	17%	167	118%	533	37%	459	50%	193	13%	67	7%	140	10%	93	10%
With Existing Caprock Pipeline Option																
Wind Erosion	8	1%	4	0%	589	41%	496	54%	357	25%	159	17%	168	12%	51	6%
Water Erosion	1,179	82%	684	75%	-	0%	-	0%	-	0%	-	0%	-	0%	-	0%
Road Construction	687	48%	467	51%	329	23%	161	18%	194	14%	194	14%	92	6%	63	7%
Shallow Excavations	89	6%	58	6%	292	20%	226	25%	777	54%	542	59%	82	6%	63	7%
Potential for Revegetation	-	0%	-	0%	18	1%	10	1%	1,145	80%	818	90%	79	6%	61	7%
Topsoil Suitability	218	15%	157	17%	559	39%	453	50%	61	4%	12	1%	381	27%	92	10%

Note: Acres will not equal total amount disturbed because not all minor soil map unit components are included in the SSURGO database.

No long-term disturbance is anticipated associated with upgrades to the existing Caprock pipeline, disturbance to soils will be temporary and soils will be stabilized following construction. Source: NRCS 2008a.

Table 4.4-3 Limitations of Soils Affected by Surface Disturbance under Preferred Alternative

	Good				Fair				Poor				Not Rated			
	Initial Disturbance		Perm Disturbance		Initial Disturbance		Perm Disturbance		Initial Disturbance		Perm Disturbance		Initial Disturbance		Perm Disturbance	
Soil Limitation	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Wind Erosion	0	0%	0	0%	581	44%	505	53%	284	21%	207	22%	0	0%	0	0%
Water Erosion	912	69%	738	77%	0	0%	0	0%	0	0%	0	0%	42	3%	29	3%
Road Construction	472	49%	400	30%	226	23%	154	12%	177	18%	161	12%	80	8%	52	4%
Shallow Excavations	84	9%	49	4%	220	23%	185	14%	570	59%	481	36%	80	8%	52	4%
Potential for Revegetation	0	0%	0	0%	16	2%	8	1%	862	90%	709	53%	77	8%	51	4%
Topsoil Suitability	272	20%	201	21%	507	38%	459	48%	29	2%	14	1%	147	11%	93	10%

Note: Acres will not equal total amount disturbed because not all minor soil map unit components are characterized in the SSURGO database.

Source: NRCS 2008a.

4.4.9 Mitigation Measures

Recommended additional mitigation measures include the following:

- During reclamation, compacted areas (typically any area that received repeated traffic or three or more passes by heavy equipment) should be subsoiled or ripped to the depth of compaction. This will help prepare the seed bed, encourage surface water infiltration, and help to prevent accelerated runoff and erosion.
- For those soils that are difficult to revegetate, structural erosion control measures should be employed. Regular monitoring of revegetated and reclaimed areas should be implemented, with regular maintenance or reseeding as needed.

Long-term topsoil stockpiles would be monitored after large precipitation events and quarterly for erosion. If erosion is noted, additional erosion control measures would be implemented to control and prevent loss of topsoil.

4.4.10 Summary of Impacts

Alterations of soils due to construction activities would be similar under all alternatives, with more acreage affected under Alternative B due to the proposed excavation of the Caprock pipelines outside the project area. Due to the clearing, grubbing, and earthmoving under all alternatives except No Action, there would be long-term impacts on soil productivity resulting from implementation of the proposed project. Stabilization of soils through revegetation of disturbed areas once construction activities are completed would take a long time to be successful due to the disruption of soil biological crusts and the high percentage of soils that are susceptible to erosion and those that have poor potential for revegetation. Monitoring and maintenance of erosion and sediment control measures and reclaimed areas would be important to ensure the successful stabilization of disturbed soils.

Implementation would result in residual impacts associated with the long-term loss of soil productivity on approximately 829 acres in the project area under the Proposed Action and Alternative C, 914 acres under Alternative B, and 962 under Alternative D. These long-term impacts are associated with the caliche surfaced roads, areas covered with aboveground structures or buildings, areas converted to ponds, caliche pits, and soils covered by pipelines. As facilities are decommissioned and portions of the project area are reclaimed these impacts would be reduced after project completion.

4.5 Air Quality

4.5.1 Issues

The primary issues related to air quality include potential air quality impacts associated with project-generated air emissions.

4.5.2 Method of Analysis

Impact analysis for air quality was performed using primarily qualitative methods by reviewing the existing air quality permits that Intrepid holds for its West, East, and North plants and assuming that similar emissions would result from the new HB mill processing facility. Preliminary data that will be submitted to NMED-AQB for an air quality permit for the new HB mill by Intrepid was used to predict the new emissions that would be generated under the action alternatives. Mobile and stationary source emissions were calculated based on established factors from AP-42 (USEPA 1995) applied to Intrepid's projections of equipment to be used for construction and operations. No modeling was completed specifically for this EIS, but the following modeling supplied by Intrepid was used to evaluate project impacts and compare to state and federal standards.

- Air dispersion modeling (FC&E Engineering 2010) that was conducted using one year of meteorological data and using the USEPA-approved AERMOD model was used to evaluate project impacts from the proposed HB mill and compare against the NAAQS and NMAAQS.
- The same air dispersion modeling was used to evaluate project impacts from the proposed HB mill and compare against modeling significance levels at the Living Desert State Park.

4.5.3 Assumptions

The assumptions used to arrive at the conclusions as part of the air quality analysis include the following:

- It is assumed that if the project were to cause or significantly contribute to an exceedence of the NAAQS or NMAAQS, this would be considered a significant impact.
- If the project were to cause a Federal Class I area or New Mexico sensitive Class II area to be adversely affected, this would be considered a significant impact if no mitigation were utilized.
- The air pollutant emission rates for the proposed HB mill based upon preliminary engineering design information, as provided by Intrepid, are assumed to accurately reflect current plans for the proposed project.

Environmental impacts to air resources would be significant if the Proposed Action or other action alternatives result in any of the following:

- Exceedence of National or State AAQS
- Exposure of sensitive receptors to substantial toxic air pollutant concentrations

4.5.4 No Action Alternative

Under the No Action Alternative, the proposed project would not be developed, and the associated air quality impacts would not occur. Under this alternative, the existing Intrepid potash mining would continue to operate under current authorizations.

4.5.5 Alternative A—Proposed Action

The Proposed Action would include new emissions sources from the proposed new HB mill and associated support facilities. Existing emissions sources at the three Intrepid Potash mines include existing permitted sources (stationary sources) and mobile sources. During construction, additional sources mostly consisting of mobile and non road engines would be involved in construction of de-watering pits and other facilities. These vehicles would have combustion emissions as well as fugitive dust emissions while traveling on paved and unpaved roads. A brief summary of the emissions from these sources is shown in the following tables.

Table 4.5-1 lists the maximum amounts that Intrepid Potash may emit from existing sources, based on existing NMED-AQB permits. Permitted sources include the new HB Mill, the East Compaction Unit, the MPI North Plant, and the West Flotation Plant. The emissions shown in the table reflect the permitted potential to emit.

Mobile source fuel usage estimates for the existing operations, the proposed HB In-Situ Solution Mine Project, and temporary sources projected to be active during the construction of the new facilities are shown in **Table 4.5-2**.

It should be noted that the emissions for construction equipment are conservative but are fairly rough estimates, and should not be considered a comprehensive emissions inventory because the exact types and models of each piece of equipment, the anticipated number of hours of operation, the estimated vehicle miles traveled or equivalent parameters are uncertain at this time. The emissions calculations are based on projected fuel consumption figures provided by Intrepid and the emission factors found in USEPA AP-42 (USEPA 1995), representing a reliable but conservative estimate of actual emissions.

Table 4.5-1 Intrepid Potash Existing Stationary Sources (Permitted Potential to Emit)

Intrepid Potash Permits	Pollutant Emissions (tpy)				
	TSP	PM_{10}	NO_X	CO	VOC
East Compaction Unit	292.4	292.4	195.1	206.6	10.7
MPI North Plant and West Flotation Plant	188.4	188.5	128.0	144.2	2.5
HB Plant	91.2	31.0	15.1	12.7	.8
Facility Totals	**572.0**	**511.9**	**338.2**	**363.5**	**14.0**

Source: NMED 2006,1999a,b, 2011.

Table 4.5-2 Estimated Fuel Usage from Intrepid's Non-Stationary Mine Sources, Existing and Proposed

Location	Diesel Use Range (gallons)		Gasoline Use Range (gallons)	
	Low	High	Low	High
Existing Operations	280,000	385,000	57,600	75,600
Proposed HB In-Situ Project	109,600	150,700	21,600	28,350
Total Operating Fuel Use	*389,600*	*535,700*	*79,200*	*103,950*
Estimated Fuel Use during Construction of Proposed HB In-Situ Project	2,017,933	2,017,933	68,079	68,079
Total Fuel Use	**2,407,533**	**2,553,633**	**147,249**	**172,029**

Source: Intrepid Potash, Inc. 2010a.

Total existing and proposed project mobile source pollutant emissions estimates from engines during construction and operation are shown in **Tables 4.5-3**, **4.5-4**, and **4.5-5**.

Table 4.5-3 Total Estimated Mobile Source Emissions from Existing Operations Based on Fuel Usage

Fuel Type	Construction and Operation Emissions (tpy)				
	NO_X	CO	VOC	SO_2	PM_{10} / $PM_{2.5}$
Diesel	116.30	25.05	9.49	7.65	8.18
Gasoline	8.01	4.86	14.89	0.41	0.49
Totals	**124.31**	**29.92**	**24.38**	**8.06**	**8.67**

Source: USEPA AP-42 emission factors (USEPA 1995) for diesel and small gasoline engines applied to the gross fuel consumption totals shown in **Table 4.5-2**.

Table 4.5-4 Total Estimated Mobile Source Emissions from Proposed HB In-Situ Project Operations Based on Fuel Usage

Fuel Type	Operations Emissions (tpy)				
	NO_X	CO	VOC	SO_2	PM_{10} / $PM_{2.5}$
Diesel	45.52	9.81	3.72	2.99	3.20
Gasoline	3.00	1.82	5.58	0.15	0.18
Totals	**48.53**	**11.63**	**9.30**	**3.15**	**3.38**

Source: USEPA AP-42 emission factors (USEPA 1995) for diesel and small gasoline engines applied to the gross fuel consumption totals shown in **Table 4.5-2**.

Table 4.5-5 Total Estimated Mobile Source Emissions during Construction of Proposed HB Project Based on Fuel Usage

Fuel Type	Construction Emissions (tpy)				
	NO_X	CO	VOC	SO_2	PM_{10} / $PM_{2.5}$
Diesel	609.59	131.32	49.76	40.09	42.85
Gasoline	7.21	4.38	13.41	0.37	0.44
Totals	**616.80**	**135.70**	**63.17**	**40.46**	**43.29**

Source: USEPA AP-42 emission factors (USEPA 1995) for diesel and small gasoline engines applied to the gross fuel consumption totals shown in **Table 4.5-2**.

4.5.5.1 Proposed New or Modified Stationary Sources

The proposed new HB mill and associated facilities would be new emission sources. This section lists the emissions sources and regulated air pollutants that may be expected to be generated from the proposed HB In-Situ Solution Mine Project facilities.

Based on the air emissions inventory, the total potential to emit from the proposed HB In-Situ Solution Mine Project would be less than the major source threshold of the Federal Operating Permit Programs under the CAA (40 CFR 70 Title V), which is 100 tpy for any regulated criteria air pollutant, less than 10 tpy of any regulated individual HAP, and less than 25 tpy of all regulated HAPs combined. Consequently, the proposed facility would not be subject to Title V major source permitting requirements and the construction of the facilities would not be subject to PSD regulations.

The projected emissions sources at the proposed new HB mill are briefly described in **Table 4.5-6** to illustrate the potential air emissions. Stationary sources are those that have a stack, baghouse, or other single emissions point. Fugitive emissions sources are those sources that could not reasonably pass through a stack, chimney, or vent and include paved and unpaved roads, conveyors, or other similar activities that do not have a single point of emission. **Table 4.5-7** lists the projected emissions from stationary and fugitive sources at the proposed new HB mill.

Emission factors were derived from AP-42 (USEPA 1995) for the combustion sources fired with natural gas, including the fluidized bed dryer, the boiler, and the amine heaters. A fuel Btu value of 1,050 Btu/standard cubic feet (scf) was used in the estimates for emissions.

Table 4.5-6 Emissions Sources Projected from the Proposed New HB Mill

Emissions Source	Description	Source Type
EP-01 Dryer Scrubber Stack	Natural gas fired fluidized bed dryer with unvented cyclone and wet venturi scrubber (16 MMBtu/hr)	Stationary
EP-02 Boiler Stack	Natural gas fired steam boiler (0.67 MMBtu/hr)	Stationary
EP-03a Amine Heater Stack	Natural gas fired amine heater #1 (6.0 MMBtu/hr)	Stationary
EP-03b Amine Heater Stack	Natural gas fired amine heater #2 (6.0 MMBtu/hr)	Stationary
EP-04a Truck Load Out	Truck loadout bin #1 equipped with baghouse	Stationary
EP-04b Truck Load Out	Truck loadout bin #2 equipped with baghouse	Stationary
EP-05 Cooling Tower	Cooling Tower	Stationary
Paved and Unpaved Roads	Haul roads associated with hauling raw materials,	Fugitive
Conveyors and Weigh Belts	Bucket elevators, belts and conveyors used to transport intermediate or final products	Fugitive
Storage Tanks	Additive and chemical storage tanks	Fugitive

Source: Intrepid Potash, Inc. 2010b.

Table 4.5-7 New Stationary Emissions Projected from the Proposed New HB Mill

	Emission Points and Annual Emissions					
Pollutant	Fluidized Bed Dryer (tpy)	Boiler (tpy)	Two Amine Heaters (tpy)	Cooling Tower (tpy)	Truck Load-outs (tpy)	Facility-wide Stationary Totals (tpy)
TSP	5.26	0.02	0.38	0.27	5.85	11.78
PM_{10}	5.26	0.02	0.38	0.27	5.85	11.78
$PM_{2.5}$	2.63	0.01	0.19	0.27	2.93	6.03
NO_X	6.67	0.28	5.01	n/a	n/a	11.96
CO	5.61	0.23	4.20	n/a	n/a	10.04
SO_2	0.04	0.002	0.03	n/a	n/a	0.07
VOC	0.37	0.02	0.28	n/a	n/a	0.67
HAPs	0.1260	0.0053	0.0473	n/a	n/a	0.18

n/a – not applicable.

Source: Intrepid Potash, Inc. 2010b.

Because ozone generation is a function of chemical reactions between NO_X and VOCs in the presence of ultraviolet radiation, potential ozone impacts can be evaluated based upon the emissions of NO_X and VOCs from the HB In-Situ Solution Mine Project. As noted in **Table 4.5-7**, NO_X emissions from the proposed new HB mill amount to 11.96 tpy, and VOC emissions from the proposed new HB mill amount to 0.67 tpy. As shown in **Table 3.5-4**, the total NO_X and VOC emissions from the primary stationary sources in Eddy County based upon 2002 emissions data are 2,677 tpy for NO_X and 1,175 tpy for VOCs.

As the projected NO_X emissions from the HB In-Situ Solution Mine Project would be less than 1 percent of the Eddy County emissions and the projected VOC emissions would be less than one tenth of 1 percent of the Eddy County emissions, it can be presumed that project emissions would result in a negligible contribution to the regional ozone ambient concentrations.

4.5.5.2 Fugitive Sources

Atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed “fugitive” because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include paved and unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations (USEPA 1995). Fugitive sources in the HB In-Situ Solution Mine project area include paved roads, unpaved roads, conveyors, and tanks.

Fugitive dust is caused by two basic physical phenomena:

1. Pulverization and abrasion of surface materials by application of mechanical force through implements (wheels, blades, etc.).
2. Entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind speeds over 19 km per hour (12 miles per hour [mph]).

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions and re-suspension of loose material on the road surface. In general terms, re-suspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas (USEPA 1995).

When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Other variables are important in addition to the silt content of the road surface material. For example, at industrial sites, where haul trucks and other heavy equipment are common, emissions are highly correlated with vehicle weight. On the other hand, there is far less variability in the weights of cars and pickup trucks that commonly travel publicly accessible unpaved roads throughout the U.S. For those roads, the moisture content of the road surface material may be more dominant in determining differences in emission levels between, for example a hot, desert environment and a cool, moist location (USEPA 1995).

Processes that have the potential to generate fugitive emissions at the proposed facility include:

- Harvest of precipitated potash and salt at the solar evaporation ponds and transport to a new flotation mill (new HB mill).
- Refinement of ore to marketable product at the new HB mill and the existing Intrepid North Plant.
- Recycling of NaCl tailings to condition the injection source groundwater.

The conveyors represent a potential fugitive emissions source; the proposed conveyors would be enclosed, thereby reducing the actual emissions. The storage tanks are considered an insignificant source of fugitive emissions. Fugitive emissions from each of the source types at the proposed HB mill and facilities to support solution mining operations including conveyors, paved and unpaved roads, and storage tanks are summarized in **Table 4.5-8**.

Table 4.5-8 Summary of Fugitive Emissions

Pollutant	Conveyors (tpy)	Paved Roadways (tpy)	Unpaved Roadways (tpy)	Storage Tanks (tpy)	Facility-wide Fugitive Totals (tpy)
TSP	Neg.	16.20	63.10	n/a	79.30
PM_{10}	Neg.	3.15	16.08	n/a	19.23
$PM_{2.5}$	Neg.	0.47	1.61	n/a	2.08
NO_X	n/a	n/a	n/a	n/a	n/a
CO	n/a	n/a	n/a	n/a	n/a
SO_2	n/a	n/a	n/a	n/a	n/a
VOC	n/a	n/a	n/a	<0.01	<0.01
HAPs	n/a	n/a	n/a	<0.01	<0.01

n/a: not applicable. Neg: Negligible

Source: Intrepid 2010b.

4.5.5.3 Ambient Air Quality Modeling

The purpose of the air dispersion modeling conducted for the proposed HB In-Situ Solution Mine project was to evaluate whether ambient air quality impacts beyond the property "fenceline" would be significant as a result of the construction and operation of the new HB mill and associated facilities. The ambient air quality modeling was performed in accordance with the NMED-AQB Dispersion Modeling Guidelines (NMED-ABQ 2010b), and addressed all regulated air pollutants that may be greater than the modeling thresholds specified in the modeling guidelines.

An ambient air quality modeling study was also conducted to demonstrate potential impacts on the Living Desert State Park (FC&E Engineering 2010), which is identified in the NMED air dispersion modeling guidelines as a sensitive Class II area. Modeling was conducted using the maximum hourly emission rate for comparison to short-term standards and annual average emission rates were used for comparison to annual standards. The latest version of AERMOD (09292) was used to determine the ambient air quality impacts due to the proposed project. The model was executed using the regulatory default option for the TSP analysis. Subsequent PM_{10} and $PM_{2.5}$ analyses were conducted using the non-default FASTALL option.

4.5.5.4 Air Quality Modeling Results

A NAAQS Analysis was conducted for TSP, PM_{10}, $PM_{2.5}$, and NO_2 but not for CO. The results of the NAAQS modeling are presented in **Table 4.5-9** along with background values and national and state ambient standards. According to New Mexico modeling guidelines, background concentrations for NO_X, CO, and SO_2 do not apply unless the source is located near Bernalillo County or El Paso. As the proposed project is not located near these areas, only the modeled concentrations are compared to the ambient air quality standards to determine compliance. Background concentrations for TSP, PM_{10}, and

$PM_{2.5}$ are added to the modeled concentrations to determine compliance. NO_2 results have been adjusted using the Ambient Ratio Method of 0.75 prior to comparison to the ambient standards.

Table 4.5-9 Summary of NAAQS Modeling Results, New HB Mill

Pollutant	Averaging Period	Modeled Results ($\mu g/m^3$)	Background ($\mu g/m^3$)	Modeled Results with Background ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	NMAAQS
NO_2	Annual	2.4	—	2.4	100	0.050 ppm
	24-hour	10.8	—	10.8	—	0.10 ppm
$PM_{2.5}$	Annual	1.73233	7.3	9.0	15	—
	24-hour	8.39213	7.3	15.6	35	—
PM_{10}	Annual	5.15941	20.0	25.1	—	—
	24-hour	17.60951	20.0	37.6	150	—
TSP	Annual	18.23126	26.6	44.8	—	60 $\mu g/m^3$
	24-hour	58.66950	26.6	85.3	—	150 $\mu g/m^3$

Source: FC&E Engineering 2010.

The maximum predicted impacts for the CO 1-hour and 8-hour averaging period were below the modeling significant impact levels; therefore, CO modeling was not required.

Emissions of NO_2, SO_2, and PM_{10} from the proposed project would consume increment because the minor source baseline date for these pollutants has been set. The results of the NO_2 and PM_{10} PSD increment analysis are presented in **Table 4.5-10**. PSD increment modeling was not required for SO_2.

Table 4.5-10 Summary of PSD Increment Modeling Results, New HB Mill

Pollutant	Averaging Period	Modeled Results ($\mu g/m^3$)	Class II Increment ($\mu g/m^3$)
PM_{10}	Annual	5.02346	17
	24-hour	17.55345	30
NO_2	Annual	2.8	25

Source: FC&E Engineering 2010.

The highest-first-high short-term modeled impact and the highest annual average modeled impact were compared to the Class II PSD increments and the facility was found to be in compliance; therefore, no additional analyses were required.

As shown in **Table 4.5-9** and **4.5-10**, a comparison of the project's maximum impacts for criteria pollutants (including background values) to the applicable AAQS indicates that there is no threat to an ambient air quality standard or PSD increment based on air dispersion modeling.

The air dispersion modeling that was conducted for Intrepid to determine potential impacts of the proposed project to the Living Desert State Park show that modeled results are well below both Class I and Class II modeling significance levels. The highest-first-high short-term and highest annual average modeled values are presented in **Table 4.5-11** along with background values and significance levels.

Table 4.5-11 Summary of Modeled Results, Living Desert State Park

Pollutant	Averaging Period	Modeled Results (µg/m^3)	Class II Modeling Significance Levels (µg/m^3)	NAAQS (µg/m^3)	NMAAQS
CO	8-hour	0.10793	500	10,000	8.7 ppm
	1-hour	0.74956	2,000	40,000	13.1 ppm
NO_2	Annual	0.00094	1.0	100	0.050 ppm
	24-hour	0.04293	5.0	—	0.10 ppm
	1-hour	1.02362	5.0	188	—
$PM_{2.5}$	Annual	0.00091	0.3	15	—
	24-hour	0.03382	1.2	35	—
PM_{10}	Annual	0.00298	1.0	—	—
	24-hour	0.05936	5.0	150	—
TSP	Annual	0.00935	1.0	—	60 µg/m^3
	24-hour	0.23073	5.0	—	150 µg/m^3

Source: FC&E Engineering 2010.

4.5.5.5 Class I Area Analysis

Experience with the Federal Land Managers' Air Quality Related Values Work Group (FLAG) 2000 recommendations in dealing with many new source review applications led the federal agencies involved to believe that an initial screen to exempt a source from AQRV impact review based on its annual emissions and distance from a Class I area may be appropriate in most situations. In October 2010, the FLMs issued proposed new guidance regarding assessment of newly proposed air emission sources on AQRVs in Class I areas. The 2010 FLAG guidance provides a method to screen out from AQRV review proposed emission sources with relatively low emissions at large distances from Class I areas. This method is referred to as the Q/D screening criteria, where Q is the sum of the short-term emission rates of SO_2, NO_X, PM_{10}, and H_2SO_4 expressed in tpy, and D is the distance from the Class I area in kilometers. A value of ≤10 would be considered to have a negligible impact on the Class I area and FLM consultation should not be required (FLAG 2010).

Based upon the 2008 FLAG Q/D methodology, emissions of SO_2+NO_X+PM_{10}+H_2SO_4 in tpy from the proposed HB In-Situ Solution Mine Project (0.07+11.96+31.02+Neg) divided by the distance to the nearest Class I area, Carlsbad Caverns National Park, in kilometers (52 km) results in a value of 0.828. This value is well below the screening value of ≤10 proposed by the FLAG, thus meeting the presumptive no adverse impact test for this screening analysis.

4.5.6 Alternative B

Under this alternative, excavation to replace existing Caprock pipelines or installation of a new Caprock line would be performed, which would result in approximately 400 acres or 279 acres, respectively, initial surface disturbance in addition to that described for the Proposed Action. All other project facilities would be essentially the same as described under the Proposed Action. Potential air quality impacts under this alternative would be slightly higher than the impacts from the Proposed Action because the additional surface disturbance would cause temporarily increased particulate matter to be released into the atmosphere along with additional combustion emissions from the construction equipment that would be used for the pipeline excavation. These impacts to air quality would be minor and temporary. All other impacts would be the same as those described under the Proposed Action.

4.5.7 Alternative C

Under this alternative, all pipelines would be buried within the pipeline ROW rather than having some pipelines located on the surface. As the total acreage of surface disturbance would be the same as that described for the Proposed Action, air quality impacts from this alternative would generally be the same. However, as more excavation would be required for the burial of the pipeline, there would be additional construction emissions from equipment for a longer period of time, resulting in slightly higher short-term air quality impacts. All other impacts would be the same as those described under the Proposed Action.

4.5.8 Alternative D—Preferred Alternative

Under this alternative, impacts would be similar to Alternative B, but with additional construction emissions as more excavation would be required for the selective burial of the pipeline, similar to Alternative C.

4.5.9 Mitigation Measures

Recommended additional mitigation measures include development of a dust control plan prior to the start of construction activities. The dust control plan would provide for methods of dust suppression such as water application to haul roads and other disturbed areas or chemical dust suppressant application where appropriate, according to accepted and reasonable industry practice. The BLM will encourage the use of equipment that meets EPA's Highway Diesel and Nonroad Diesel Rules for project construction and maintenance operations.

4.5.10 Summary of Impacts

No significant adverse impacts to air quality would occur under any alternative because state and federal air quality standards would not be exceeded.

No long-term residual impacts to air quality from implementation of the proposed project would occur because reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established following reclamation, particulate matter emission levels should return to what is typical for an arid environment.

4.6 Climate Change

4.6.1 Issues

Recent scientific evidence suggests there is a direct correlation between climate change and emissions of GHGs. Although many GHGs occur naturally in the atmosphere, human-caused sources have substantially increased the emissions of GHGs since the Industrial Revolution. The primary issues related in climate change include the potential contribution of GHGs by the project.

4.6.2 Assumptions and Method of Analysis

While global and national GHG inventories are being established, regional and state-specific inventories are in varying levels of development. Techniques for quantification of GHG emissions also are in the development stages. There is a relatively good understanding of GHG emissions related to fuel usage

Analytical tools necessary to quantify climatic impacts at the local level are presently unavailable. As a consequence, impact assessment of specific effects of human activities can only be evaluated qualitatively.

USEPA emission factors and estimated fuel usage from Intrepid's non-stationary mine sources were used to evaluate project impacts that may affect climate change.

4.6.3 No Action Alternative

Under the No Action Alternative, the proposed project would not be developed, and the associated climate change impacts would not occur. Under this alternative, the Intrepid's existing potash mines and processing facilities would continue to operate under current authorizations. GHG emissions from existing operations are identified in **Tables 4.6-1** and **4.6-2**.

4.6.4 Alternative A—Proposed Action

Table 4.6-1 provides the calculated GHG (carbon dioxide equivalent [CO_2e]) emissions from electricity used by Intrepid and provided by others. Non-road and mobile sources at Intrepid's operations contribute to the generation of CO_2 emissions. These are calculated from estimated fuel consumption provided by Intrepid, shown in **Table 4.6-2**. Secondary sources of GHG include electricity generated offsite and used to provide electrical service to the mine. Intrepid's estimated annual electrical usage is given in **Table 4.6-3**.

Table 4.6-1 Intrepid's Estimated Annual CO_2e Emissions from Electrical Power Generated by Others

	Emissions from Electrical Usage GHG CO_2 (metric tons) Emission factor: 7.18×10^{-4} metric tons CO_2e / kWh	
Location	**Low**	**High**
Existing Operations	91,186	105,546
Proposed HB Project	23,263	28,433
Total	**114,449**	**133,979**

Source: USEPA GHG emission factor of 7.18×10^{-4} metric tons CO_2 / kWh applied to estimates of electrical usage from Intrepid Potash (Table 4-8) (USEPA 2005).

Table 4.6-2 Intrepid's Non-stationary Mine Sources Estimated GHG CO_2e Emissions

	Diesel GHG CO_2 (metric tons) (EF: 10.1 kg/gal CO_2)		**Gasoline GHG CO_2 (metric tons) (EF: 8.89 kg/gal CO_2)**	
Location	**Low**	**High**	**Low**	**High**
Existing Operations	2,828	3,889	512	672
Proposed HB Project	1,107	1,522	192	252
Total	**3,935**	**5,411**	**704**	**924**

Source: USEPA GHG emission factors of 10.1 kg CO_2 per gallon for diesel and 8.89 kg CO_2 per gallon for gasoline applied to estimated fuel usage from Intrepid Potash.

Table 4.6-3 Intrepid's Estimated Annual Electrical Usage

Location	Electrical Usage Range (kilowatt hour [kWh])	
	Low	**High**
Existing Operations	127,000,000	147,000,000
Proposed HB Project	32,400,000	39,600,000
Total	**159,400,000**	**186,600,000**

Source: Intrepid Potash, Inc. 2010a.

There would be temporary power sources associated with construction for the development of new facilities in the HB In-Situ Solution Mine project area. GHG CO_2e emissions for these temporary sources are calculated from anticipated fuel usage and are shown in **Table 4.6-4**. Emission factors for GHG emissions are derived from USEPA (2005), as follows:

- Diesel—10.1 kilograms per gallon (kg/gal) of fuel
- Gasoline—8.89 kg/gal of fuel

Table 4.6-4 Estimated GHG CO_2e Emissions from Construction Sources for the HB In-Situ Solution Mine Project

	Diesel GHG CO_2 (metric tons)	Gasoline GHG CO_2 (metric tons)
Construction Sources	20,381	605

Source: USEPA GHG emission factors of 10.1 kg CO_2 per gallon for diesel and 8.89 kg CO_2 per gallon for gasoline applied to estimated fuel usage from Intrepid Potash.

4.6.5 Alternative B

Under this alternative, increased excavation to replace existing Caprock pipelines or installation of the new Caprock pipe will be required. All other project facilities would be the similar to those described for the Proposed Action. Potential climate change impacts under this alternative would be relatively the same as the impacts from the Proposed Action, as the additional combustion emissions from the construction equipment that would be used for the pipeline excavation would be negligible on a global scale.

4.6.6 Alternative C

Under this alternative, all pipelines would be buried within the pipeline ROW rather than having some pipelines located on the surface. The additional GHG emissions from the construction equipment that would be required for the excavation due to the burial of the pipelines would be negligible on a global scale.

4.6.7 Alternative D—Preferred Alternative

Under this alternative, impacts would be similar to Alternative B. The additional GHG emissions from construction equipment required for pipeline burial would be negligible on a global scale, similar to Alternative C.

4.6.8 Mitigation Measures

Climate change mitigation measures include the implementation of process and energy efficiency programs. As it is in the best interest of Intrepid to conduct operations in as an efficient manner as possible for fuel conservation purposes, process and energy efficiency methods should be incorporated into operational practices.

4.6.9 Summary of Impacts

Impacts to greenhouse gas emissions would be similar across all of the action alternatives. No significant residual impacts to global climate change from the proposed project would occur.

4.7 Vegetation

4.7.1 Issues

The primary issues associated with vegetation resources include:

- Damage to vegetative cover and diversity, surface water flow, groundwater withdrawal, special status plant species, and forage in rangeland areas.
- The introduction or spread of noxious weeds and invasive plants.
- The loss of vegetative cover due to trampling, soil compaction, the direct removal of vegetation and changes in surface water flow resulting from surface-disturbing activities, construction and production activities, aboveground facilities, and subsidence.

4.7.2 Method of Analysis

Potential impacts to vegetation resources were determined based on the locations of these resources in relation to the proposed surface disturbance areas. Using GIS, the locations of proposed surface disturbances, potential subsidence areas, and areas where groundwater drawdown is projected to occur within 40 feet of the surface were overlaid on the vegetation layer to determine the amount of acreage lost for each vegetation type. To determine if known populations or individuals of special status species would be impacted, the locations of proposed surface disturbances and potential subsidence areas were overlaid on available special status plant species GIS layers to determine if known populations or individuals would be affected. Where appropriate and reasonable, suitable habitat was identified for each species and overlaid with the surface disturbance and potential subsidence areas to determine the amount of suitable habitat that would be lost due to the proposed project. Applicant committed measures, and BLM regulations were assumed to be implemented in determining significant impacts.

4.7.3 Assumptions

The following assumptions were used in the analysis of impacts to vegetation resources:

- Areas of recently disturbed bare ground would be more susceptible to erosion and invasion by non-native species.
- Erosion from disturbed areas would be minimal once vegetation or other surface stabilization is established. Successful establishment of herbaceous vegetation generally takes a minimum of 3 to 5 years, depending on soil and precipitation, and requires monitoring until the BLM determines the reclamation to be successful.
- Extensive networks of roads and utility corridors can lead to fragmentation of native landscapes, which can decrease species diversity, lead to decrease in the number and populations of native and special status species, and provide corridors for invasion of non-native species.

- Areas with rehabilitation constraints (e.g., highly erodible or droughty soils, low precipitation amounts, etc.) can have little to no reclamation success, unless additional mitigation measures are implemented.
- Surface disturbance activities result in the conversion of shrub and tree-dominated vegetation cover types to grass/forb-dominated vegetation in the short term.
- Groundwater withdrawals may result in the conversion of riparian vegetation cover types to upland-dominated vegetation.
- Vegetation types most affected by groundwater drawdown are located in areas where the current groundwater level is 40 feet or less from the ground surface. It is assumed that the roots of woody vegetation may extend as deep as 40 feet for moisture.

The thresholds for significant impacts to vegetation are dependent on the extent of surface impacts and the length of time necessary for the native vegetative communities to recover following surface disturbance. Impacts to vegetation resources would be significant if the Proposed Action or alternatives result in one or more of the following:

- New noxious weed species are introduced into the project area, or existing species spread into areas that were previously dominated by native species.
- Loss of special status plant populations, individuals, or conditions that would reduce the ability of the species to maintain its current population status.

4.7.4 No Action Alternative

Under the No Action Alternative, the proposed project would not be approved. Current land use and surface-disturbing activities would continue as currently authorized. No additional surface disturbance or effects on groundwater withdrawal related to potash mining beyond those currently authorized would occur in the project area.

4.7.5 Alternative A—Proposed Action

4.7.5.1 General Vegetation

Under the Proposed Action, 1,022 acres would be removed or impacted due to surface disturbance activities associated with construction and operation of the in-situ mining project. Surface disturbance activities include construction and permanent footprint of groundwater pumping wells, injection and extraction well networks, surface piping system, evaporation ponds, and a new flotation mill. The majority of the disturbance would occur in the Mesquite Upland Scrub and Desert Scrub vegetation cover types. Less than 10 acres of disturbance would affect the riparian, woody riparian and water cover types, while less than 1 acre of disturbance would occur in the Dune and Sand Flat Scrub. **Table 4.7-1** identifies estimated acreage of project-related disturbance by vegetation cover type within the project area. Vegetation cover types in the project area can be found in **Figure 3.7-1**. In addition, vegetation along existing access roads would be affected (e.g., reduction in growth rate) as a result of dust deposition.

Table 4.7-1 Acreage of Affected Vegetation under the Proposed Action Alternative

Vegetation Cover Type	Acres of Temporary Impacts	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
Desert Scrub	346	<1	276	<1
Dune and Sand Flat Scrub	<1	<1	<1	<1
Grassland	44	<1	35	<1

Table 4.7-1 Acreage of Affected Vegetation under the Proposed Action Alternative

Vegetation Cover Type	Acres of Temporary Impacts	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
Mesquite Upland Scrub	597	2	488	1
Riparian	<1	<1	<1	<1
Sandhill Shrubland	28	<1	25	<1
Water[1]	2	<1	1	<1
Woody Riparian	5	<1	3	<1
Total	**1,022**	**3**	**829**	**2**

[1] Includes water land cover type where ROWs overlap. Actual waterbodies would be avoided.

Short-term impacts from project-related activities would include the trampling of herbaceous vegetation, clearing/blading of surface cover, and removal of vegetation for construction. Long-term impacts would include the permanent loss of vegetation for permanent facilities during the life of the project, and the conversion of shrub-dominated cover types to grass/forb-dominated vegetation due to surface clearing activities and changes in soil chemistry from operational activities or if spills of salt brine or salt precipitants were to occur. Vegetative communities also could be affected by damage to biological soil crusts.

Impacts to vegetation could result from groundwater withdrawals for operational activities. Decreases in groundwater depth in areas where the groundwater is currently close to the surface could result in changes in vegetation community composition and structure. Drawdown would decrease root zone soil moisture in areas where the existing groundwater levels are within 40 feet of the surface. In the project area, the groundwater is within this range in the north and central areas, centered around Clayton Lake (see **Figure 3.3-8**). The groundwater drawdown also would potentially affect areas of vegetation outside the project area that are located where the groundwater water is currently within 40 feet of the surface.

In and near the project area, maximum groundwater drawdown is projected to vary from 100 to 200 feet below current groundwater levels over the lifetime of the project. Maximum pumping would occur during the first seven years of the project, and then decrease. Because the aquifer would most likely remain at lowered groundwater levels for an extended period of time (due to slow recharge), changes in plant communities would be long-term. See **Table 4.7-2** to view the vegetation types that would potentially be affected by groundwater drawdown resulting from pumping the Rustler Formation (preferred model and enhanced model).

Table 4.7-2 Acreage of Vegetation Community Types Potentially Affected by Groundwater Drawdown, Proposed Action

Vegetation Type	Acres Affected by Drawdown (where groundwater is currently within 40 feet of surface)	
	Preferred Model	Enhanced Model
Desert Scrub	2,561	2,622
Grassland	836	840
Mesquite Upland Scrub	5,932	6,044
Riparian	123	135

Table 4.7-2 Acreage of Vegetation Community Types Potentially Affected by Groundwater Drawdown, Proposed Action

Vegetation Type	Acres Affected by Drawdown (where groundwater is currently within 40 feet of surface)	
	Preferred Model	Enhanced Model
Sandhill Shrubland	5	6
Water	1,004	1,095
Woody Riparian	639	655

Vegetative community types that would be the most affected by groundwater pumping would be the ones where the groundwater is the closest to the surface (0 to 10 feet). The acres of vegetation that are located where the groundwater is currently 10 feet or less from the surface are shown in **Table 4.7-3**.

Table 4.7-3 Acreage of Vegetation Types Where Current Groundwater Depth is Near Surface

Vegetation Type	Acres Where Groundwater is within 10 feet from the Surface
Desert Scrub	386
Grassland	113
Mesquite Upland Scrub	362
Riparian	54
Water	841
Woody Riparian	545

Mesquite Upland Scrub and Desert Scrub are the dominant vegetation types in the areas where the groundwater is currently within 40 feet of the surface. Where the groundwater is currently within 10 feet of the surface, the predominant vegetative community types are Woody Riparian and Mesquite Upland Scrub. The species in these areas are adapted to arid conditions but may use a combination of surface water and groundwater. While it is unknown which water source is used predominantly by the vegetative community types, it is likely in the areas where the groundwater is within 10 feet of the surface that these species use groundwater resources at some point in the growing season.

The vegetation composition and structure response of various vegetation communities to long-term drawdown stress varies depending on the underlying soil textures, chemistry, and water holding capacity; the relative influence of seasonal and annual precipitation; and the adaptations of individual species to drought stress. The response of the vegetation community types to the changes in soils moisture also is affected by the rate of groundwater drawdown while pumping occurs. Typically, the germination and survival of young plants is more dependent on the availability of steady water resources. Mature trees and shrubs are better adapted to surviving drought conditions and changes in water resources.

It is expected that drawdown-induced root zone stress would result in a successional sequence that would transition the riparian and woody riparian vegetative communities from wetland and riparian species to upland species better adapted to lower soil moisture levels. As soil moisture decreases, it is anticipated that water-dependent species would become less vigorous, and less able to compete against upland species that would slowly take over these areas. Over the long term these areas would be invaded by less water dependent species and upland vegetation types, depending on the surface flow inputs, soil salinity, and alkalinity. Impacts would be seen sooner in herbaceous riparian communities where the species roots are shallower. The woody riparian species would potentially be able to follow the declining water table down with continued root growth to the limit of their root zones. For cottonwoods and willows the maximum root depth is typically 20 feet; these species would most likely start to decline once groundwater levels dropped below that point.

The grassland and desert scrub communities would most likely persist in this drawdown area, but would be less vigorous (lower height, lower densities, and lower reproductive potential). The upland mesquite scrub community would most likely persist in the drawdown area and may spread into areas that are being negatively impacted by drawdown effect. The mesquite tree has deep plastic roots that are capable of following the water table as it draws down, and also growing laterally to find pockets of surface water sources.

If drought conditions occur in the area, vegetation composition changes would increase. Recovery of these areas once groundwater pumping is stopped and the aquifer levels are returned to pre-project levels would depend on climate conditions, soil changes, and post-groundwater drawdown vegetation composition.

4.7.5.2 Invasive Plants

Indirect effects on vegetation would include the spread of noxious and invasive species, fugitive dust, and fragmentation of vegetative communities resulting from the development of the network of utility ROWs, access roads, and surface pipelines. In the areas disturbed by the Proposed Action, Malta star-thistle, African rue, Lehmann's lovegrass, and goldenrod have been identified along existing pipelines, and roads in the project area.

Surface disturbance and increased vehicle travel along new routes may readily spread noxious weeds and invasive plant species and colonize areas that have minimal vegetation cover or areas that have been recently disturbed. Noxious weed species can degrade and modify native communities, reduce resources for native species, and adversely affect native pollinators.

To stabilize the growth media, reduce soil erosion, and minimize the potential for the establishment of noxious weeds and invasive species, the operators would implement the applicant-committed environmental protection measures, as well as the BLM-required lease stipulations and environmental protection measures (Section 2.4.5), and compliance with the NPDES Construction General Permit plans.

Areas not needed for operations would be reclaimed as soon as construction activities are complete. During operation of the project, the lease stipulations require the operators to continue to identify areas where surface disturbances can be reduced. At the end of the project, all structures and infrastructure would be removed, and disturbed areas would be revegetated. During reclamation, caliche would be removed from the disturbed areas. Vegetation cover types would recover at varying rates, with herbaceous-dominated plant communities typically taking 3 to 5 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations.

Woody-dominated plant communities would require at least 20 to 40 years for shrubs to re-colonize the area. Reclamation efforts may take longer in some areas due to poor soil conditions, and changes in soil chemistry from groundwater drawdown, and potential spills during operation activities. In areas affected by groundwater drawdown, vegetation communities may take decades to recover to pre-project conditions, or may not return to pre-construction compositions, density, or structure due to permanent changes in soil chemistry.

4.7.5.3 Special Status Species

Scheer's Beehive Cactus

Scheer's beehive cactus is found in desert grassland and Chihuahuan desert scrub. These two vegetation communities occur in the project area, and would be impacted by surface-disturbing activities associated with the Proposed Action. **Table 4.7-4** identifies acres of potential habitat for the species in the project area based on SWReGAP landcover data. Due to the limited knowledge of the species, and its distribution, it is unknown whether the species occurs in the project area. If the species did occur in the project area, direct impacts from surface-disturbing activities would include the loss of individuals, and populations, and suitable habitat. Indirect impacts would result from the spread of noxious weeds, effects of fugitive dust, increased erosion, and potential changes in soil chemistry.

Table 4.7-4 Potential Scheer's Beehive Cactus Habitat

Vegetation Type	Acres of Temporary Impact	Percent of Project Area	Acres of Permanent Impact	Percent of Project Area
Desert Grassland and Chihuahuan Desert Scrub	377	1	300	1

Source: USGS 2004.

Gypsum Wild Buckwheat

Gypsum wild buckwheat is found in sparsely vegetated areas and is restricted to almost pure gypsum soils. Gypsum soils are found in the project area, and are impacted by surface-disturbing activities associated with the Proposed Action Alternative. **Table 4.7-5** identifies acres of potential habitat for the species in the project area based on NRCS SSURGO data (NRCS 2008a). Due to the limited distribution of the species, it is unlikely it is found in the project area.

Table 4.7-5 Potential Gypsum Wild Buckwheat Habitat

Vegetation Type	Acres of Temporary Impact	Percent of Project Area	Acres of Permanent Impact	Percent of Project Area
Gypsum Soils	128	<1	89	<1

Source: NRCS 2008a.

4.7.6 Alternative B

4.7.6.1 General Vegetation

Under Alternative B, impacts in the project area would be same as under the Proposed Action, except that the northernmost Rustler wells and pipelines would not be constructed. For this alternative, Caprock water from Intrepid's existing wells east of the project area would be used as either a supplemental or the primary water source. Intrepid has proposed three alternatives to transport the water to the project area. It is assumed that either Caprock pipeline option 2 or 3 would be implemented for the purposes of this EIS. Option 2 would improve Intrepid's existing main pipelines from the Caprock well fields to transport the water to the project area, and option 3 would be the installation of a new Caprock pipeline that would head south from the Caprock well fields, then parallel to NM 62/180 on the north side of the road until it enters the project area. **Table 4.7-6** summarizes the acreage of vegetation types affected under Alternative B for the three Caprock pipeline options up to the project area boundary.. The types and extent of impacts to vegetation resources from surface disturbance activities in the project area would be similar to that described for the Proposed Action.

Table 4.7-6 Acreage of Vegetation Types within Project Area and Caprock Pipeline ROWs Affected by Construction under Alternative B

Vegetation Type	Acres of Temporary Impacts	Percent of Area Affected[1]	Acres of Permanent Impacts	Percent of Area Affected[1]
Project Area and New Caprock Pipeline ROW				
Desert Scrub	377	<1	274	1
Dune and Sand Flat Scrub	6	<1	—	<1
Foothill Shrubland	<1	<1	—	<1
Grassland	142	<1	36	<1
Mesquite Upland Scrub	736	2	492	1
Riparian	<1	<1	<1	<1
Sandhill Shrubland	44	<1	25	<1
Water[2]	3	<1	1	<1
Woody Riparian	6	<1	2	<1
Total	**1,314**	**3**	**830**	**2**
Project Area and Existing Caprock Pipeline Option				
Desert Scrub	387	<1	283	<1
Dune and Sand Flat Scrub	5	<1	2	—
Foothill Shrubland	0	—	<1	—
Grassland	154	<1	64	<1
Mesquite Upland Scrub	803	2	530	1
Riparian	<1	<1	<1	<1
Sandhill Shrubland	79	<1	30	<1
Water	2	<1	1	<1
Woody Riparian	4	<1	3	<1
Total	**1,435**	**4**	**914**	**2**

[1] Area affected includes project area plus Caprock pipeline ROWs listed.

[2] Includes water land cover type where ROWs overlap. Actual waterbodies would be avoided.

The impacts to vegetative resources from groundwater drawdown would be less under this alternative compared to the Proposed Action, because the majority of the groundwater drawdown would occur in areas where the groundwater table is greater than 40 feet below the surface (see **Figures 4.3-9** and **4.3-12**). See **Table 4.7-7** to view the vegetation community types that would potentially be affected by groundwater drawdown resulting from pumping the Rustler Formation and the additional Caprock wells for both pumping rates (preferred calibration, and enhanced calibration). Under Alternative B for the

Preferred Calibration, only four vegetative community types would be impacted (Desert Scrub, Grassland, Mesquite Upland Scrub, and Woody Riparian).

Table 4.7-7 Acreage of Vegetation Community Types Potentially Affected by Groundwater Drawdown, Alternative B

Vegetation Type	Acres Affected by Drawdown (where groundwater is currently within 40 feet of surface)	
	Preferred Model	Enhanced Model
Desert Scrub	483	1,579
Grassland	738	425
Mesquite Upland Scrub	1,332	3,282
Riparian	0	70
Sandhill Shrubland	0	6
Water	0	202
Woody Riparian	6	56

The acres of vegetation that are located where the groundwater is 10 feet or less from the surface are shown in **Table 4.7-8**. Only the Grassland vegetative type would be affected under the Preferred Model pumping for Alternative B.

Table 4.7-8 Acreage of Vegetation Types Where Current Groundwater Depth is Near Surface, Alternative B

Vegetation Type	Acres Affected by Drawdown (where groundwater is currently within 10 feet of surface)	
	Preferred Calibration	Enhanced Calibration
Desert Scrub	0	28
Grassland	94	9
Mesquite Upland Scrub	0	59
Riparian	0	5
Water	0	11
Woody Riparian	0	7

Mesquite Upland Scrub and Grassland are the dominant vegetation types in the areas where the groundwater is currently within 40 feet of the surface for the Preferred Model pumping rate. For the Enhanced Model pumping rate, the Mesquite Upland Scrub and Desert Scrub are the dominant vegetation types that would be affected by drawdown. Where the groundwater is currently within 10 feet of the surface, the predominant vegetative community types affected would be Grassland for the Preferred Model pumping rate, and Mesquite Upland Scrub and Desert Scrub for the Enhanced Model pumping rate. For the upland community types, impacts would be similar to those described for the Proposed Action.

4.7.6.2 Invasive Plants

Impacts in the project area under Alternative B would be similar to those described for the Proposed Action.

4.7.6.3 Special Status Species

Impacts to sensitive plant species from surface disturbance activities in the project area would be the same as described for the Proposed Action.

Scheer's Beehive Cactus

Table 4.7-9 identifies acres of potential habitat for the Scheer's beehive cactus species in the project area and for the pipeline routes (existing and proposed) under Alternative B based on SWReGAP landcover data.

Table 4.7-9 Potential Scheer's Beehive Cactus Habitat Affected under Alternative B

Vegetation Type	Acres of Temporary Impacts	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
With Proposed New Pipeline				
Desert Grassland and Chihuahuan Desert Scrub	420	1	297	1
With Existing Caprock Pipeline Option				
Desert Grassland and Chihuahuan Desert Scrub	420	1	308	1

Gypsum Wild Buckwheat

Table 4.7-10 identifies acres of potential habitat for the gypsum wild buckwheat species in the project area and for the pipeline routes (existing and proposed) under Alternative B based on SWReGAP landcover data and SSURGO data (NRCS 2008a).

Table 4.7-10 Potential Gypsum Wild Buckwheat Habitat Affected

Vegetation Type	Acres of Temporary Impacts (inside Project Area)	Percent of Project Area	Acres of Temporary Impacts[1] (outside Project Area)	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
Gypsum Soils	138	<1	0	0	89	<1

[1] Includes existing and proposed new Caprock pipelines.

4.7.7 Alternative C

Under Alternative C, impacts would be the same as under the Proposed Action. Surface disturbance acreages in the project area would be the same as for the Proposed Action. Interim reclamation would occur on the areas disturbed for construction of the pipelines and other facilities. Impacts from groundwater drawdown would be the same as those described for the Proposed Action.

4.7.8 Alternative D—Preferred Alternative

4.7.8.1 General Vegetation

The BLM selected aspects of Alternatives B and C to be included in the Preferred Alternative. Under the Preferred Alternative, there would be over 100 acres of additional long term surface disturbance associated with construction and operations, compared to the Proposed Action and 50 acres more, compared to Alternative B. All of the process plans would be the same as described for Alternative A, Proposed Action, but there would be some adjustments to the construction schedule. **Table 4.7-11** summarizes the acreage of the vegetation types affected within the project area under the Preferred Alternative. The types of impacts to vegetation resources from surface disturbance activities in the project area would be similar to those described for the Proposed Action.

Table 4.7-11 Acreage of Vegetation Types within Project Area and Caprock Pipeline ROW Affected by Construction under the Preferred Alternative

Vegetation Type	Acres of Temporary Impacts	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
Desert Scrub	404	1	299	<1
Dune and Sand Flat Scrub	5	<1	1	<1
Grassland	142	<1	65	<1
Mesquite Upland Scrub	723	2	558	1
Riparian	<1	<1	<1	<1
Sandhill Shrubland	48	<1	34	<1
Water	3	<1	1	<1
Woody Riparian	5	<1	3	<1
Total	**1,331**	**3**	**962**	**2**

The impacts to vegetative resources from groundwater drawdown under this alternative would be the same as described for Alternative B.

4.7.8.2 Invasive Plants

Impacts in the project area under Preferred Alternative would be similar to those described for the Proposed Action except that there would be an increased chance of invasive species spreading along the new Caprock Pipeline corridor.

4.7.8.3 Special Status Species

Impacts to sensitive plant species from surface disturbance activities in the project area would be the same as described for the Proposed Action.

Scheer's Beehive Cactus

Table 4.7-12 identifies acres of potential habitat for the Scheer's beehive cactus species in the project area under Preferred Alternative based on SWReGAP landcover data.

Table 4.7-12 Potential Scheer's Beehive Cactus Habitat Affected within the Project Area and Caprock Pipeline ROW

Vegetation Type	Acres of Temporary Impacts	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
Desert Grassland and Chihuahuan Desert Scrub	443	<1	326	<1

Gypsum Wild Buckwheat

Table 4.7-13 identifies acres of potential habitat for the gypsum wild buckwheat species in the project area under Preferred Alternative based on SWReGAP landcover data and SSURGO data (NRCS 2008a).

Table 4.7-13 Potential Scheer's Gypsum Wild Buckwheat Habitat Affected within the Project Area and Caprock Pipeline ROW

Vegetation Type	Acres of Temporary Impacts	Percent of Project Area	Acres of Permanent Impacts	Percent of Project Area
Gypsum Soils	135	<1	91	<1

4.7.9 Mitigation Measures

Recommended additional mitigation measures include the following:

- A noxious weed management plan should be developed that includes pre-construction surveys, education of construction and operation personnel, during construction activities the washing of vehicles and equipment before entering and leaving the project area, herbicide spraying, and annual monitoring.
- Surveys should be conducted in areas where surface disturbance is planned in or near potential habitat for Scheer's beehive cactus. If the species is identified as occurring in the disturbance footprint, surface-disturbing activities should be moved to be a minimum of 200 feet away from individual plants or populations.

4.7.10 Summary of Impacts

The greatest impacts to vegetation communities from drawdown would occur under the Proposed Action and Alternative C. The highest acreage of surface disturbance and alterations to vegetative cover would occur under the Preferred Alternative. There is a small potential for damage to sensitive plants that could be mitigated by implementing surveys prior to finalizing construction plans and locations. Implementation of a noxious weed management plan would minimize the potential for the spread and establishment of noxious weeds during construction activities and vehicle travel during project operations.

Residual impacts from surface-disturbing activities would include the permanent loss of 829 acres of native vegetation under the Proposed Action and Alternative C, 914 acres under Alternative B, and 962 acres under the Preferred Alternative. In addition, habitat fragmentation would be a result of the increased road and surface pipeline network. Noxious weed and invasive species may persist over the long term regardless of the implementation of control programs. Residual impacts from surface-disturbing activities for each alternative would be relatively the same.

Residual impacts from groundwater drawdown would include the potential for permanent conversion of wetland and riparian vegetation to upland communities. The communities may not return to pre-project conditions due to potential changes in soil chemistry, climate conditions, and changes in vegetation composition.

Impacts resulting from surface-disturbing activities and groundwater drawdown in combination would be likely to result in the spread of mesquite and other noxious or invasive weed species into disturbed areas.

4.8 Wildlife and Fish

4.8.1 Issues

Wildlife species and related issues addressed in this analysis were determined through consultation with the BLM and USFWS. The primary issues related to wildlife and fisheries include:

- Potential impacts to special status species, especially sand dune lizard, and lesser prairie-chicken that would contribute to their being listed as federally threatened or endangered.
- Disruption of natural mammal and reptile movement corridors and cumulative loss of habitat.
- Potential loss of raptor nest sites.
- Potential adverse impacts to migratory birds from the creation of hypersaline evaporation ponds.

4.8.2 Method of Analysis

Potential impacts to wildlife and sensitive species resources were determined based on the locations of these resources in relation to the proposed surface disturbance areas. Correlations between the vegetation types and habitat types were established. Using GIS, the locations of proposed surface disturbance were overlaid on the vegetation type layer to determine the amount of acreage lost for each habitat type.

To determine if known populations or individuals of special status species, would be affected, the locations of proposed surface disturbance were overlaid on known sensitive species GIS layers to determine if known populations or individuals would be located within the planned areas of disturbance. In addition, where appropriate and reasonable, suitable habitat was identified for each species where surface disturbance is projected to determine the amount of suitable habitat that would be lost due to the proposed project. Applicant-committed measures and BLM regulations were taken into account in determining significant impacts.

The potential impacts on terrestrial wildlife from implementation of the action alternatives can be classified as short-term and long-term. Short-term impacts may arise from habitat removal and disturbance as well as from activities associated with mine operations. These impacts would cease upon mine closure and completion of successful reclamation.

Long-term impacts consist of permanent changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success. Direct impacts to wildlife populations could include direct mortality caused by construction activities, habitat loss or alteration, incremental habitat fragmentation, animal displacement, and the potential for increased vehicle-related mortalities.

Indirect impacts could include increased noise and human presence.

4.8.3 Assumptions

The following summarizes the impact analysis assumptions for wildlife and sensitive species resources affected by the proposed project. The following assumptions were used in the analysis of impacts to wildlife and sensitive species resources:

- Installation of maintenance roads would increase disturbance of wildlife species and fragmentation of native habitat.
- Increased vehicle presence from the proposed project would contribute to disruption of wildlife populations and movement corridors.
- Installation of new power lines would increase the potential for migratory bird collisions with power lines. Additionally new power lines would increase the potential for roosting locations for raptors and other predatory birds.
- Installation and the continued use of saline evaporation ponds could increase the potential for migratory birds (and other terrestrial wildlife species) to attempt to use the ponds. Acute or chronic toxicity of migratory birds would occur if birds came into contact with hypersaline water in the evaporation ponds.
- Increased human activities and the increase in construction, maintenance, and utility corridors associated with the new mill, pumps, surface piping and evaporation ponds is likely to affect wildlife movement, use of native habitat, and increase the potential for wildlife mortality.

Environmental impacts to wildlife and fisheries would be significant if the alternatives result in any of the following:

- Disturbance of federally threatened or endangered terrestrial or aquatic wildlife species or their critical habitat, or disturbance of USFWS species of concern or BLM sensitive species contributes to their being listed as threatened or endangered.
- Adverse impacts to nesting raptor or passerine species protected under the MBTA, or loss of an active nest site, as a result of construction or operations during the breeding season.
- Destruction of active bat roosts or maternity sites.

The threshold for significant impacts to wildlife and sensitive species depend on the extent of surface impacts and the length of time necessary for native vegetative communities to recover following surface disturbance. Additionally, wildlife and sensitive species thresholds are dependent on the extent and duration of changes to habitat that would result from the long-term operation and maintenance of the proposed project. Impacts to wildlife or sensitive species would be significant if implementation of the proposed project results in one or more of the following:

- The loss of sensitive species populations or individuals that would adversely affect the ability of the species to maintain its current population status.
- Sensitive species habitat would be altered as part of the construction and maintenance of the proposed project.
- Migratory birds would be killed or damaged by project facilities.

4.8.4 No Action Alternative

Under the No Action Alternative, the proposed HB In-Situ Solution Mine Project would not be approved. Current land and resource uses would continue under current conditions in the project area. No additional ground-disturbing activities related to potash mining beyond those currently authorized would occur in the project area.

4.8.5 Alternative A—Proposed Action

4.8.5.1 Terrestrial Wildlife

Potential impacts to wildlife species from the Proposed Action would result from the incremental short-term loss of approximately 1,022 acres of habitat within the proposed project area. Impacts also would result in the long-term loss of approximately 829 acres of habitat from the construction of the pipelines, evaporation ponds, new HB mill, and other facilities needed to operate the proposed project. Other potential impacts to wildlife include increased vehicle traffic, increased human activity, increased exposure to hypersaline ponds, and increased habitat fragmentation within the project area.

Construction

Direct impacts to big game species (primarily pronghorn and mule deer) include the incremental loss of forage and would result in an incremental increase in habitat fragmentation from the installation of new roads and surface pipelines. However, these incremental losses of vegetation would represent a small percentage (less than 2.5 percent) of the overall available habitat within the project area.

The loss of native vegetation would be long-term, most likely greater than 20 years. Herbaceous species and grasses may become established within 3 to 5 years, depending on reclamation success. In most locations, suitable habitat adjacent to construction disturbance areas (i.e., new pipelines, transmission lines, maintenance roads, well pads, mill, and evaporation ponds) would be available for these big game species until grasses and woody vegetation are reestablished within the disturbance areas. The predominant vegetation that would be affected by construction disturbance is Mesquite Upland Scrub and Desert Scrub. They would be replaced by native grasses and herbaceous plants during initial reclamation and revegetation, which would attract big game species as well as many small game and nongame species that utilize grasslands and herbaceous feed and cover.

The construction of above-ground pipelines and associated roads would dissect the landscape and may alter travel routes for game species. Big game would not be adversely affected by this fragmentation for several reasons. The pipelines would be buried at least every quarter mile, so while this may alter some existing travel routes, the pronghorn and javelinas would be able to move along the pipe and cross at the locations where the pipe is buried, or mule deer could jump over the obstruction (18 inches or less). While the aboveground pipelines and roads would dissect the landscape, the patches created would be in areas of open vegetation that is similar on both sides of the pipelines and extending for long distances without creating edge effects. Direct impacts to small game species (e.g., scaled quail, bobwhite quail, black-tailed jackrabbit, and desert cottontail) would include nest or burrow abandonment or loss of eggs or young from the removal or crushing of natural habitat during construction due to disruption from human activity. Wildlife movements within the project area would be directly altered by the aboveground pipelines.

Construction would result in the mortality of some less mobile or burrowing nongame species (e.g., small mammals, nesting birds, reptiles, amphibians, invertebrates) as a result of crushing from vehicles and construction equipment. Other impacts include the short-term displacement of some of the more mobile species (e.g., medium-sized mammals, adult birds) as a result of surface disturbance activities. The habitats adjacent to the proposed disturbance areas may support some displaced animals.

If surface-disturbing activities occur near nesting sites during the breeding season for passerines (approximately March 1 through August 31), impacts would result in nest or territory abandonment, loss of eggs or young resulting in the loss of productivity for the breeding season. For species protected under the MBTA, the loss of an active nest site, incubating adults, eggs, or young would be a violation of the MBTA. However, the extent of impacts to nesting birds would depend on the nest location relative to the actual locations of construction, the phase of the breeding period, and the level and duration of the disturbance.

Nesting raptors located close to construction locations would be likely to abandon their breeding territory or nest site, or may experience the loss of eggs or young as a result of surface disturbance activities. These losses, if they were to occur, would reduce productivity for that breeding season. The degree of these impacts would depend on a number of variables including the location of the nest site, the species' relative sensitivity to disturbance, and breeding cycle.

New and rerouted overhead power lines could pose an electrocution hazard for raptor species attempting to perch on the structures and would slightly increase collision potential for migrating and foraging birds. Collision potential typically is dependent on variables such as the location of the power lines in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors, visibility, and line design (APLIC 1994).

Indirect impacts would result from increased noise levels and human presence during construction. Big game animals (pronghorn and mule deer) would likely decrease their use within areas surrounding surface disturbance activities. However, this displacement would be short-term and animals would return to the area following construction activities. Indirect impacts would include the temporary displacement of small game from the construction areas as a result of increased noise and human activities. Displacement of small game animals from construction areas would be short-term and animals would return following construction activities where habitat remains available.

Potential impacts to big game species from construction activities would be minimized through implementation of the applicant-committed and BLM environmental protection measures summarized in Section 2.5.4. Potential impacts to nongame species from construction activities would be minimized through implementation of the mitigation measures identified at the end of this section along with the implementation of the BLM Environmental Protection Measures (2.3.1, Karst Features; 2.3.2, Surface Disturbance Buffer; and 2.5.2.1, Raptor Protection).

Operations

Direct impacts to many of the wildlife species from the operation and maintenance activities associated with the Proposed Action would include the incremental long-term habitat loss or alteration of potential breeding or foraging habitats until native vegetation has become reestablished.

The projected groundwater drawdown under the Proposed Action would cause changes to the vegetation types and the associated wildlife habitat in the locations identified in Section 4.7.5.1, Vegetation. Species that rely on habitat in the vegetation types that would be altered due to groundwater drawdown would be adversely affected. This includes the 836 acres of the grassland vegetation types, 762 acres of the riparian vegetation type, and 8,493 acres of the shrub-dominated vegetation types that would be affected by groundwater drawdown in the project area (see **Table 4.7-2**). Grasslands, riparian areas, and shrub-dominated vegetation provide habitat to mule deer and pronghorn, as well as most small game and nongame species currently located within the project area. Changes to this habitat would affect all species. However, because there is adequate habitat nearby, the impacts to wildlife would not be significant.

Big game species could be adversely affected if groundwater drawdown causes sources of natural fresh water locations to dry up, forcing species to travel greater than normal distances to find water. This situation may also entice wildlife to attempt to find new watering sources from the evaporation ponds, which would not be healthy.

The potential exposure of small mammals to hypersaline water in the evaporation ponds may result in acute or chronic salt toxicity. Once the new evaporation ponds become fully operational, salt levels within the ponds would become concentrated, much more than natural playa lakes in the region. Due to the lack of surface water bodies in the region, the evaporation ponds would be likely to attract a variety of migratory bird species, causing bird disease or mortality unless deterrents are employed. Any MBTA species that land on the hypersaline evaporation ponds are very likely to experience acute or chronic toxicity.. Studies conducted on hypersaline playa lakes in southeastern New Mexico (Meteyer et al. 1997) during spring and fall migrations have shown that, "when birds remained on the lakes for prolonged periods of time, such as during stormy weather, a heavy layer of salt precipitated on their feathers. This precipitate was then ingested by the birds through frequent preening of salt-laden feathers," causing sodium toxicity and often death. As little as 4 grams of salt can be lethal to birds (USFWS 2009b). According to the USFWS (Hudson 2010), the hypersaline tailings pond associated with a potash mine in the SPA caused high mortality rates of migratory birds until hazing and other mitigation measures were employed.

Indirect impacts to wildlife species would result from the increase in habitat disruption from the increase of vehicle traffic and human presence for operation and maintenance activities. The most common wildlife responses to noise and human presence are avoidance or accommodation. Avoidance would result in displacement of animals from an area larger than the actual disturbance area. It is not possible to predict the total extent of habitat lost as a result of wildlife avoidance response, because the degree of this response varies from species to species and can vary between different individuals of the same species. After initial avoidance of human activity and noise, certain wildlife species would acclimate to the activity and reoccupy areas formerly avoided. For example, during the initial development phases, it is likely that big game (pronghorn and deer) would be displaced from a larger area than the actual disturbance sites due to the avoidance response. Avoidance distances of 100 to 200 meters are common for some big game species (Lyon 1983). However, these big game species have demonstrated the ability to acclimate to infrequent vehicle traffic and a variety of mining activities as long as human harassment levels do not increase substantially. It is possible, therefore, that the extent of displacement would approximate the actual disturbance area along roads, wells, and in the mill area, after the first few years of project operations. As a result, impacts to wildlife species associated with human presence and noise would be low.

4.8.5.2 Aquatic Species

The project area has various wetlands, playas, salt ponds, and ephemeral streams. No detailed biological inventories have been performed in caves, but BLM specialists believe that the caves within and near the project area provide habitat for troglobitic species that rely on water. However, until an inventory is completed, it is unknown if the caves support aquatic species so no conclusion can be made regarding the potential impact on cave-dwelling aquatic species. The impacts of drawdown on caves are discussed further in Section 4.2.5.1.

Continued pumping of water from the Rustler wells may decrease water flows to the Pecos River downstream of the project area. Not enough is known about the relationship between flows from Nash Draw and flows in the Pecos River to determine whether instream river flows would be reduced or would affect aquatic species in the river.

4.8.5.3 Sensitive Species

The impact analysis for sensitive wildlife species focused on those species that were identified as potentially occurring within the project area (see **Table 3.8-1**). Impacts to species that could potentially be affected by the Proposed Action are presented below.

A total of 15 terrestrial species (5 special status species and 10 species of special concern) have been identified as potentially occurring within the project area. Without detailed data regarding the actual location of each of these species within the project area, it can only be concluded that potential impacts to sensitive wildlife species would parallel those discussed above for terrestrial wildlife in the construction and operations phases of the Proposed Action. No adverse effects to sensitive species are anticipated.

Implementation of the BLM Environmental Protection Measures (2.3.1, Karst Features; 2.3.2, Surface Disturbance Buffer; 2.5.2.1, Raptor Protection; 2.11.1.1, Raptor Nests and Heronries; 2.11.2.1, Prairie Chickens; and 2.11.2.2, Sand Dune Lizards) and mitigation measures identified below in Section 4.8.6, would reduce potential impacts to sensitive wildlife resources. As a result, overall impacts to sensitive species are considered to be low.

4.8.6 Alternative B

4.8.6.1 Terrestrial Wildlife

Impacts to terrestrial wildlife from the construction and operation of Alternative B would be similar to the impacts outlined for the Proposed Action within the project area.

Additional impacts to wildlife species would occur from Alternative B because of the increased disturbance of native habitats from the proposed improvements to the Caprock pipelines. The excavation of the existing lines would initially affect 400 acres of native wildlife habitat. The disturbed vegetation within the ROW would be reestablished following excavation and no long-term disturbance would be incurred. If the new Caprock pipeline is implemented, 279 acres of native wildlife habitat would be altered initially. In addition, the new Caprock pipeline would require 84 acres of long-term disturbance for an access road in the pipeline ROW. Revegetation efforts would not be the same as pre-construction native environments for many years.

4.8.6.2 Aquatic Species

The impacts to aquatic species would be similar to or less than that described for the Proposed Action due to the less extensive groundwater drawdown in the vicinity of the project area.

4.8.6.3 Sensitive Species

In the project area, impacts to sensitive species from the construction and operation of Alternative B would be similar to the impacts outlined for the Proposed Action.

Current BLM management requires avoiding surface disturbance within any occupied or adjacent suitable habitat for the sand dune lizard. No surface disturbance is allowed in occupied habitat areas or within 100 meters (328 feet) of suitable habitat associated with occupied habitat areas. BLM management guidelines correspond to state and federal agency guidance to protect the sand dune lizard. Currently, the sand dune lizard is under consideration by the USFWS for formal listing as a threatened species, with the final decision expected in December, 2011. If the decision is made to list this species, then formal consultation will be initiated with the USFWS and a biological assessment will be developed to analyze the effect of the preferred alternative on the species and its habitat.

The existing Caprock pipelines are routed through occupied sand dune lizard habitat. The 50-foot ROW for the new Caprock pipeline does not cross occupied sand dune lizard habitat. BLM Environmental Protection Measure 2.11.2.2 would disallow excavation at many locations along the existing Caprock pipeline due to sand dune lizard habitat but would not preclude construction of the new Caprock pipeline based on current regulations. If critical habitat is designated as part of the federal listing decision, additional restrictions on construction of the new Caprock pipeline may be established at that time.

No surface disturbance is allowed within 200 meters (656 feet) of lesser prairie-chicken leks. The closest lesser prairie-chicken lek is approximately 240 feet away from the existing Caprock pipelines. The existing pipeline also lies within the area of BLM lesser prairie-chicken timing restrictions. BLM Environmental Protection Measure 2.11.2.1 would limit the timing of construction (not allowed from March 1 through June 15) and locations of improvements to the existing pipelines (not within 200 meters of lesser prairie chicken leks). The new Caprock pipeline ROW does not cross any leks or buffers. Portions of the line intersect with the BLM timing restriction area.

Compliance with environmental protection measures would likely minimize or avoid adverse effects to sensitive species under Alternative B. These restrictions may directly affect Intrepid's decision to excavate the existing Caprock pipelines because there are few locations where excavation would not be constrained by sand dune lizard restrictions.

4.8.7 Alternative C

Impacts to terrestrial wildlife and special status species from the construction and operation of the proposed project under Alternative C would be similar to impacts outlined for the Proposed Action. By burying the pipelines, habitat fragmentation and other obstructions to wildlife movement would be lessened compared to the Proposed Action.

4.8.8 Alternative D—Preferred Alternative

4.8.8.1 Terrestrial Wildlife

The types of impacts to terrestrial wildlife from the construction and operation of the Preferred Alternative would be similar to the impacts outlined for the Proposed Action within the project area.

Additional impacts to terrestrial wildlife would occur under the Preferred Alternative as an additional 309 acres from initial impacts and 133 acres from long-term impacts would affect wildlife habitat in the project area. Construction of the new Caprock pipeline would result in 285 acres of native wildlife habitat that would be altered by construction activities. In addition, the new Caprock pipeline would have 85 acres of long-term disturbance associated with an access road in the pipeline ROW. Revegetation would not replace pre-construction native environments for many years. Similar to Alternative C, by burying 68 percent of the pipelines under the Preferred Alternative, habitat fragmentation and other obstructions to wildlife movement would be lessened compared to the Proposed Action.

Impacts to migratory birds and other wildlife species from exposure to hypersaline water may be more pronounced under the Preferred Alternative due to the increased surface acreage (additional 62 acres) of the evaporation ponds compared to the Proposed Action.

4.8.8.2 Aquatic Species

The impacts to aquatic species would be similar to or less than that described for the Proposed Action due to the less extensive groundwater drawdown in the vicinity of the project area.

4.8.8.3 Sensitive Species

Impacts to sensitive species from the construction and operation of the proposed project under the Preferred Alternative would be similar to impacts outlined for Alternative B. In addition, the new Caprock pipeline route would be installed along an alignment designed to avoid sand dune lizard habitat. Old Caprock lines would not be reconstructed but would be maintained as long as it does not require excavation in sand dune lizard habitat.

Compliance with environmental protection measures would likely minimize or avoid adverse effects to sensitive species under the Preferred Alternative.

4.8.9 Mitigation Measures

In order to minimize impacts to terrestrial wildlife, aquatic species, and special status species, mitigation measures have been developed in coordination with the BLM and USFWS. Recommended additional mitigation measures include the following:

- Eight-foot-high fencing should be installed around the evaporation ponds at the base of the earthen berms to minimize access by terrestrial wildlife species.
- Bird deterrents should be installed at the evaporation ponds to minimize potential impacts to avian wildlife species (Murphy 2010). Potential deterrents include:

  - Netting, pond covers, or floating "bird balls," as appropriate.
  - Construct a mesh-net canopy over each pond to prevent access by birds.
  - Use trained dogs to harass birds from area.
  - Install a grid of gravel access roads to facilitate regular maintenance and hazing of birds.
  - Routine patrolling and firing shell crackers or other pyrotechnic devices.
  - Plant and manage tall, robust vegetation to discourage use by some waterbird species that typically loaf on land near water.
  - Install commercially available bird scaring devices employing noise or radar.
  - Install wire lines over ponds with reflective tape or ribbon. Monitoring of bird deterrents should be performed to evaluate their effectiveness and to allow for changes to measures through adaptive management should some mitigations prove unsuccessful.
- If watering locations within the project area dry up due to groundwater drawdown of the aquifer, install new watering facilities or provide supplemental water for use by wildlife species.
- Avoid removing large trees, large mesquite, and large yuccas (if present) to protect potential nesting habitat or coordinate with the BLM to identify alternative protection measures.
- Follow trenching guidelines developed by New Mexico Game and Fish Department to minimize mortality to reptiles and small mammals during buried pipeline and utility installation.
- Conduct surveys for sand dune lizard and lesser prairie-chicken along proposed pipeline routes that cross known habitat.
- Do not revegetate shinnery oak dune habitat where disturbed for installation of any Caprock pipeline.
- At the end of the project, remove all caliche from access roads and revegetate except in shinnery oak dune habitat.

Intrepid developed and is committed to implementing an avian monitoring and mitigation plan designed to anticipate and prevent use of the ponds by waterfowl and the resulting risk of mortality.

4.8.10 Summary of Impacts

Impacts to wildlife and sensitive species from the Proposed Action are expected to have a minimal effect on species populations. Although impacts would be minimal, there would be effects that could be long-lasting to certain wildlife species, especially small mammals, reptiles, and birds. Changes in plant communities would result from groundwater drawdown in riparian areas, as well as some grasslands and shrub habitats. These vegetation changes would be most prominent under the Proposed Action and Alternative C due to the extensive pumping of the Rustler Formation in the project area. The effect of groundwater drawdown on cave-dwelling species is unknown until biological inventories of the caves can be completed.

The installation of surface pipelines under the Proposed Action and Alternative B would block wildlife movements. In comparison, Alternative C and the Preferred Alternative would minimize adverse impacts to wildlife movements because a portion or all of the pipelines in the project area would be buried, depending on the alternative. Under the Preferred Alternative, the new Caprock pipeline would be installed along an alignment designed to avoid sand dune lizard habitat. The old Caprock pipelines would not be reconstructed but would be maintained as long as no excavation in sand dune lizard habitat is required. These measures would avoid adverse impacts to the sand dune lizard and its habitat.

Adverse impacts to wildlife and sensitive species that are common to all four action alternatives include increased vehicle traffic, increased noise levels, and drawdown of groundwater levels. The implementation of the applicant-committed and BLM environmental protection measures, along with recommended mitigation measures, would minimize adverse impacts to wildlife and sensitive species to a point where impacts would not be significant.

4.9 Rangelands and Livestock Grazing

4.9.1 Issues

The primary issues associated with range resources include direct and indirect impacts associated with the loss of forage, potential impacts to existing water sources and range improvements, and potential impacts to seasonal livestock movement within grazing allotments.

4.9.2 Method of Analysis

Potential impacts to rangelands and livestock grazing resources were determined based on the locations of these resources in relation to the proposed surface disturbance areas. The locations of proposed surface disturbances, and potential subsidence areas were overlain on the grazing allotment and range improvement layers to determine the acreage lost of each grazing allotment, and which if any range improvements would be affected.

4.9.3 Assumptions

The following summarizes the impact analysis assumptions for rangelands and livestock grazing that would be affected by the proposed project. Impacts to rangelands and livestock grazing resources would be significant if the proposed project results in the permanent loss of AUMs or an allotment becoming non-functional (i.e., no longer able to support livestock grazing).

The following assumptions were used in the analysis of impacts to rangeland and livestock grazing resources:

- An increase in the number of roads and vehicular traffic would contribute to difficulties for livestock management and increase the potential for livestock-vehicle collisions.
- Loss of water sources may decrease the AUMs that could be grazed on an allotment or may require supplemental water to be provided.
- Aboveground pipelines would not severely restrict cattle access to grazing because they would be buried at least every 0.25 mile.
- Surface disturbance and the long-term existence of surface pipelines and other facilities would reduce the AUMs in grazing allotments.
- Applicant-committed measures, required lease stipulations, and Conditions of Approval required by BLM policy and guidelines (see Section 2.5.4) were taken into account in determining impacts.

4.9.4 No Action Alternative

Under the No Action Alternative, the proposed project would not be approved. Grazing management would continue as currently authorized. No additional surface disturbance or effects on groundwater withdrawal related to potash mining beyond those currently authorized would occur in the project area.

4.9.5 Proposed Action

Under the Proposed Action, impacts to range resources would result from surface-disturbing activities including the construction and operation of well pads, pipelines, overhead utilities, and roads, and the impacts on surface water resources and vegetative communities resulting from the decrease in the groundwater depth due to pumping. **Table 4.9-1** identifies the acreage of initial disturbance per allotment, the number of livestock AUMs affected per allotment, and the percentage of AUMs that would be lost from surface-disturbing activities under the Proposed Action. The number of AUMs lost was calculated based on an average number of AUMs per acre for the grazing allotment acreage lost. Initial disturbance associated with surface-disturbing activities would result in impacts to 1,022 acres on five BLM grazing allotments, resulting in the loss of 125 AUMs over the life of the project. The loss of AUMs in each allotment is less than 1 percent, except in the Maroon Cliffs grazing allotment. Permanent disturbance would result in the long-term loss of 829 acres and 81 AUMs in the project area. Most of the AUMs lost in the Maroon Cliffs allotment are on private land owned by Intrepid.

Table 4.9-1 Impacts to Carrying Capacity by Allotment Due to Initial Disturbance under the Proposed Action

Grazing Allotment Name	Allotment Disturbance in Project Area (ac.)	Active AUMs Lost in Project Area (no.)	Percent Loss of Total Active AUMs
Clayton Basin	78	16	<1%
Fenton Draw	9	1	<1%
Maroon Cliffs	711	86	4%
Mimosa	6	1	<1%
Twin Wells North	218	21	<1%
Total	**1,022**	**125**	

Groundwater withdrawals would affect 836 acres of the Grassland vegetation type, 762 of the Riparian vegetation types, and 8,493 of the Shrub-dominated vegetation community types (see **Table 4.7-2**). Groundwater withdrawals would decrease the amount of water available for livestock water sources, especially base water wells and groundwater wells located in allotments affected by the groundwater withdrawals. In the project area, the grazing allotments under Section 3 of the Taylor Grazing Act are permitted with water as the base property. To qualify for a Section 3 grazing permit, the permittee must have land or water capable of serving as the base for livestock operations (base property), which is defined as either land or water controlled or owned by the permittee. In the project area, there are five base water wells that could lose their water supply or be severely reduced by project-related groundwater pumping (see **Table 3.9-4**). Outside the project area, there are an additional two base water wells that could be adversely affected by groundwater drawdown in the Clayton Basin and Brushy Knob grazing allotments.

Reductions in the base water wells would affect the terms of the grazing permits and could potentially lead to a reduction in AUMs allowed for the grazing allotment unless an alternate water source were identified to serve as the base property for the grazing permit. In addition, due to the semi-arid climate and lack of reliable water sources in much of the project area, a decrease in the water available to supply groundwater wells that serve as livestock water sources is likely to reduce the areas available for grazing. Without a reliable water source, many areas currently available for grazing would not be able to support livestock.

Direct effects from construction and operation activities would result from surface-disturbing activities, increased vehicle traffic, possible damage to range improvements (fences, gates, and water sources), and increased road and utility networks. Surface-disturbing activities would result in the short-term loss of forage from facility construction, and long-term loss from the placement of permanent facilities, and the potential conversion of native vegetative communities due to impacts from increased erosion and invasion and spread of noxious and invasive weed species. Vegetation treatment projects in the north and east parts of the project area could be affected by surface-disturbing activities associated with construction and operation activities.

An increase in the number of roads and traffic could lead to increased mortality and injuries to livestock, and may cause disruptions to livestock management. Construction and operation activities may disrupt livestock management by limiting access to grazing areas and range improvements, and may restrict or alter livestock movements.

The loss of forage may result from changes in vegetation communities due to groundwater drawdown. See Section 4.7, Vegetation and Section 4.3, Water, for a further discussion on the effects of groundwater pumping on surface water resources and vegetation composition.

Indirect impacts would include the potential spread of noxious and invasive species, fugitive dust, and the fragmentation of grazing allotments. Following surface-disturbing activities, noxious weeds and invasive plant species may readily spread and colonize areas that typically lack or have minimal vegetation cover or areas that have been recently disturbed.

4.9.6 Alternative B

Under Alternative B, impacts to the project area would be similar to the Proposed Action, except that the northernmost Rustler wells and pipelines would not be constructed. For this alternative, Caprock water from Intrepid's existing wells east of the project area would be used as either a supplemental or the primary water source. **Table 4.9-2** summarizes the acreage of initial disturbance per allotment, the number of livestock AUMs affected per allotment, and the percentage of AUMs that would be lost from surface-disturbing activities under Alternative B for both the existing and proposed new Caprock pipeline routes. Impacts to range resources from surface disturbance activities in the project area would be slightly less than that described for the Proposed Action. In the existing and proposed new Caprock pipeline ROWs, surface disturbance and changes to range resources in BLM allotments would be greater outside the project area than under the Proposed Action.

Table 4.9-2 Impacts to Carrying Capacity by Allotment Due to Initial Disturbance under Alternative B

Grazing Allotment Name	Allotment Disturbance (ac.)	Active AUMs Lost (no.)	Percent Loss of Total Active AUMs
With Proposed New Caprock Pipeline			
Buckeye North	30	<1	<1
Buckeye South	24	No Data	No Data
Clayton Basin	94	21	<1
Fenton Draw	9	1	<1
Halfway	16	4	<1
Hart Ranch	38	1	<1
Laguna Tonto	21	11	<1
Laguna Totson	13	4	<1
Maljamar II	1	<1	<1
Maroon Cliffs	711	86	4
Mimosa	6	1	<1
Salt Lake	18	No Data	No Data
Twin Wells North	242	23	<1

Table 4.9-2 Impacts to Carrying Capacity by Allotment Due to Initial Disturbance under Alternative B

Grazing Allotment Name	Allotment Disturbance (ac.)	Active AUMs Lost (no.)	Percent Loss of Total Active AUMs
Total	1,223	152	6
With Existing Caprock Pipeline Option			
Buckeye North	38	<1	<1
Buckeye South	33	No Data	No Data
Clayton Basin	166	34	<1
Fenton Draw	9	1	<1
Halfway	15	3	<1
Laguna Tonto	21	10	<1
Laguna Totson	9	2	<1
Little Lake	4	<1	<1
Maljamar II	26	2	8
Maljamar South	34	3	<1
Maroon Cliffs	736	88	4
Mimosa	6	1	<1
Querecho Plains	9	1	<1
Salt Lake	34	No Data	No Data
Twin Wells North	274	26	<1
West Bilbrey	15	2	<1
Total	**1,429**	**173**	**14**

Note: Not all of the Caprock pipelines fall within BLM grazing allotments, so total acreage affected is less than the total amount of surface disturbance under this alternative.

If the existing Caprock lines are no longer used to transport water to the project area and the processing plants, a few ranchers that obtain water from these lines based on informal agreements with Intrepid may lose a source of water for livestock grazing. Intrepid may choose to provide an alternative water source for livestock grazing based on a private agreement if the existing Caprock pipelines are retired from use.

The groundwater drawdown would be less extensive in the project area than under the Proposed Action and would not have a major effect on forage availability because most of the drawdown would occur in areas where the existing groundwater table is greater than 40 feet below the surface (see **Figures 4.3-9** and **4.3-12**). Impacts to base water and groundwater wells would be less than that described under the Proposed Action due to the smaller extent of groundwater drawdown.

4.9.7 Alternative C

Under Alternative C, impacts would be the same as under the Proposed Action, except that all pipelines would be buried. Surface disturbance acreage would be the same as for the Proposed Action, with more initial excavation. Interim reclamation would occur on the areas disturbed for the construction of the pipelines. Once successful reclamation is achieved in these areas, livestock grazing could be resumed. Impacts to livestock management during the life of the project would be less than under either the

Proposed Action or Alternative B, mainly because there would be no surface pipelines blocking livestock movements or excluding the use of forage along the pipeline ROWs.

4.9.8 Alternative D—Preferred Alternative

Under the Preferred Alternative, impacts to the project area would be similar to the Proposed Action, except that there would be additional surface disturbance associated with construction and operation activities under this alternative. Greater surface disturbance increases the chance of the spread of invasive species along the new Caprock pipeline corridor. The BLM selected aspects of Alternatives B and C to be included in the Preferred Alternative. This alternative includes approval of Intrepid's revised HB In-Situ Solution Mine Operation and Closure Plan, granting new ROWs, approval of lease modifications, and approval of permits to drill new water supply, injection, extraction, and monitoring wells. All of the process plans would be the same as described for Alternative A—Proposed Action but there would be some adjustments to the construction schedule. For further discussion of the Preferred Alternative, and the specific differences between the Preferred Alternative and the Proposed Action see Section 2.2.5. **Table 4.9-3** identifies the acreage of initial disturbance per allotment, the number of livestock AUMs affected per allotment, and the percentage of AUMs that would be lost from surface-disturbing activities under the Preferred Alternative. The number of AUMs lost was calculated based on an average number of AUMs per acre for the grazing allotment acreage lost. Initial disturbance associated with surface-disturbing activities would result in impacts to 1,272 acres on thirteen BLM grazing allotments, resulting in the loss of 148 AUMs over the life of the project. The loss of AUMs in each allotment is less than 1 percent, except in the Maroon Cliffs grazing allotment. Permanent disturbance would result in the long-term loss of 944 acres and 94 AUMs in the project area.

Table 4.9-3 Impacts to Carrying Capacity by Allotment Due to Initial Disturbance under the Preferred Alternative

Grazing Allotment Name	Allotment Disturbance in Project Area (ac.)	Active AUMs Lost in Project Area (no.)	Percent Loss of Total Active AUMs
Buckeye North	30	<1	<1
Buckeye South	24	—[1]	—[1]
Clayton Basin	112	20	<1
Fenton Draw	9	1	<1
Halfway	16	3	<1
Hart Ranch	42	2	<1
Laguna Tonto	22	11	<1
Laguna Totson	13	4	<1
Maljamar II	1	<1	<1
Maroon Cliffs	736	88	4
Mimosa	10	1	<1
Salt Lake	18	—[1]	—[1]
Twin Wells North	239	19	<1
Total	**1,272**	**148**	

[1] Active allotment information is not available for this grazing allotment.

Note: Not all of the Caprock pipelines fall within BLM grazing allotments, so total acreage affected is less than the total amount of surface disturbance under this alternative.

4.9.9 Mitigation Measures

Impacts to grazing allotments would be minimized through the implementation of the applicant-committed environmental protection measures, the lease stipulations and environmental protection measures required by BLM policy and guidelines, and the NPDES Construction General Permit. During construction, these measures would minimize surface impacts, soil erosion, and the potential for the establishment of noxious weeds and invasive species. Surface disturbance would be minimized by the utilization of existing surface disturbance, minimization of total surface disturbance, and the co-location of pipelines along existing roads and ROWs. Restrictions to livestock movement would be minimized by the burying of the pipe every quarter mile to wildlife and livestock crossings.

Range improvements would be avoided, or moved if avoidance is not feasible. If livestock water sources cannot be avoided, they would be moved a minimum of 200 feet away from construction and operation activities. Any fences damaged during construction would be repaired. If a range improvement is found to be within the construction footprint, impacts to the range improvement would be minimized by avoidance or moving it if avoidance is not feasible. If livestock water sources cannot be avoided, they would be moved a minimum of 200 feet away from construction and operation activities.

Areas not needed for operations would be reclaimed as soon as construction activities are complete. During operation of the project, the lease stipulations require the operators to continue to identify reductions in surface disturbances and the reclamation of these areas. Final reclamation would occur at the end of the life of the project. All structures and infrastructure would be removed, and disturbed areas would be revegetated. During reclamation, caliche would be removed from the disturbed areas. Re-establishment of herbaceous species would take 3 to 5 years, while tree and shrub species could take 20 to 50 years. Once successful reclamation has been achieved in these areas, livestock grazing could be resumed.

Vegetation treatment projects seek to increase native grasslands, and reduce the cover and number of invasive native and non-native shrubs (creosote, mesquite, and tamarisk). Successful reclamation of these areas with native grasses and forbs could assist in restoring the native grasslands in these historically disturbed areas. Recommended additional mitigation measures include the following:

- Speed limits should be followed and signs would be erected to warn vehicle operators of construction and project-related traffic.
- Exclusion fencing around the evaporation ponds should be installed to keep livestock out during construction and project operation.
- If the supply to base water and other water wells is sufficiently decreased by groundwater withdrawals so the Section 3 grazing permits are adversely affected or there is a long-term decrease in the level of active AUMs, then alternative water sources should be provided or developed by Intrepid.

4.9.10 Summary of Impacts

The primary impacts to rangelands and livestock grazing would be reductions in forage and changes to livestock movements. The greatest impacts would occur under the Proposed Action and Alternative B because the aboveground pipelines would occupy space currently used for forage and would block livestock movements. The Preferred Alternative would have greater surface disturbance than the Proposed Action, but would have a decreased impact on forage availability and animal movement due to the burial of 68 percent of the pipelines in the project area. Alternative C, with its buried pipelines, would allow for more forage availability, and less blockage to animal movements, although the new access roads may affect travel patterns. No alternative would result in significant impacts to rangelands or livestock grazing. The adverse impacts from groundwater pumping would be minimized through the mitigation measures.

Residual impacts would include the loss of up to 1,429 acres and 148 AUMs associated with the Caprock pipeline ROWs over the life of the project, depending on which Caprock pipeline option is selected. Other residual impacts include the establishment of noxious weed and invasive species unless weed management is implemented. Noxious weed and invasive species may persist over the long term regardless of the implementation of control programs, thus resulting in the reduction of available forage. The increased number of roads and pipelines would fragment the allotments and alter livestock movements, and may result in an increased number of vehicle-livestock collisions.

See Section 4.7, Vegetation, for a discussion of the residual impacts from groundwater pumping on the vegetation communities.

4.10 Lands and Realty

4.10.1 Issues

Land use issues associated with the proposed project include:

- Surface disturbance and visual resource alterations that are inconsistent with land use plans.
- New roads along pipelines may increase public access where none previously existed.
- Subsidence may affect existing and future land use and access in the project area.
- Increased traffic on Highway 62/180, as well as on local roads.

4.10.2 Method of Analysis

Analysis of impacts to lands and realty was completed primarily using a qualitative evaluation of how the proposed project would affect current land uses and transportation in the project area and the region. Using GIS, the projected subsidence areas were overlaid on the land ownership and existing infrastructure to identify structures that might be affected.

4.10.3 Assumptions

Assumptions for analysis are as follows:

- New roads within pipeline ROWs would increase public access and may promote unauthorized use.
- Project-related vehicle traffic would temporarily affect public traffic on highways to/from Carlsbad and local roads within the project area.
- New ROWs may limit the locations of future land use changes.
- Large-diameter pipelines would limit emergency vehicle access.
- Existing infrastructure (i.e., pipelines and roads) could be impacted by subsidence.
- Actions that impede present land and mineral uses authorized by the 1986 Order would have an adverse impact on land use and transportation.

4.10.4 No Action Alternative

Under the No Action Alternative, in-situ mining activities would not take place within the project area so there would be no change to lands, realty, and transportation activities beyond the currently authorized activities.

4.10.5 Alternative A—Proposed Action

The proposed project and alternatives would affect lands managed by the BLM, the State of New Mexico, Intrepid, and other private landowners. Land ownership in relation to proposed project facilities is displayed on **Figure 2-1**. New ROW authorizations would be required where pipelines, roads, wells, and power lines, and other infrastructure would be located on BLM lands. Three overhead power lines owned by Xcel, two buried New Mexico Gas pipelines, and one AT&T fiber optic line in the vicinity of the proposed evaporation ponds would have to be moved before construction begins. The total length of the ROWs to be relocated can be found in **Table 2-3**. The establishment of these new ROWs may limit other future land uses that require facilities in the project area for the life of the solution mining project (28 years). Other uses common in the area that could be affected include OHV trails and oil and gas development.

New access roads would not be gated so they would open up public access for unauthorized OHV or other vehicle use. Furthermore, aboveground pipelines may be considered a challenge or an obstacle to be crossed by aggressive motorized and non-motorized vehicle riders. Both of these unauthorized uses would require increased BLM signage and enforcement.

While subsidence resulting from the Proposed Action is projected to be minimal, it may affect current land uses such as existing oil and gas infrastructure. The Colglazier 2 Oil Well is slightly within the potential subsidence area, and there is an oil pipeline connecting several wells with tank batteries that slightly overlaps the projected subsidence area. Additionally, an oil pipeline runs northwest and southeast through the area of potential subsidence. There are no residences or outbuildings within the projected subsidence area.

Pipelines would be installed under NM 360 at four locations and under U.S. 62/180 at two locations within the project area. Because the pipelines would be bored under the roads, little or no interruption of traffic would occur during construction.

Heavy equipment would be mobilized and moved into and out of the project area, depending on specific activities, during the 18-month construction period. During some construction activities, there would be frequent traffic to and from Carlsbad by such vehicles as concrete trucks and service trucks, in addition to the daily travel by construction workers. While the greatest impact to transportation would be increased traffic and the use of new and existing roads during construction, the current traffic to, from, and within the project area is relatively light and well within the capacity of the existing roads.

During project operations, service vehicles would check pipelines using the roads within the pipeline ROWs daily. Once potash is produced in the evaporation ponds (beginning approximately 3 years after construction of the project), there would be large scrapers driving between the ponds and the salt loadout area, and periodic trips by 24-ton tractor trailer trucks along a private haul road between U.S. 62/180 and the new HB mill. There also would be daily travel by the employees (36) to the new HB mill. The effect of additional project-related travel on area roads during construction and operations would not significantly affect normal traffic levels.

4.10.6 Alternative B

Under Alternative B, impacts would be similar to that described for the Proposed Action. In order to provide more water from existing wells, Intrepid would either build a single new Caprock pipeline or would replace existing buried Caprock pipelines within the same ROWs. These pipelines would cross U.S. 62/180, NM 529, and CR 222/Shugart Road. Because the pipelines would be bored under the roads, little or no interruption of traffic would occur during construction. The construction of the new Caprock pipeline would add 46 miles to the existing pipeline network within the Carlsbad Field Office jurisdiction. The excavation and installation or replacement of the Caprock pipelines crosses primarily public land, but also small portions of state and private land.

New permits and ROW authorizations would be required to enter state land for any of the pipelines, and a new BLM ROW permit would be required where they cross public lands. Permission to enter private lands would require separate negotiations between Intrepid and private landowners. Intrepid would be responsible for obtaining all permits and ROW grants from the appropriate agencies.

As a result of implementation of either pipeline option, a temporary increase in vehicle traffic between the project area and the Caprock well fields by construction employees would be expected.

4.10.7 Alternative C

Under Alternative C, all pipelines would be buried but BLM ROW permits would still be required for all project facilities on public lands. Potential safety hazards caused by motorized and non-motorized vehicle rider potential use of aboveground pipelines would not occur under Alternative C. The new access roads along the pipeline ROWs would still provide increased public access to the area, requiring BLM enforcement. There would be slightly fewer impacts than the Proposed Action.

4.10.8 Alternative D—Preferred Alternative

Under the Preferred Alternative, impacts in the project area would be similar as those described for Alternative B, except that 68 percent of the proposed pipelines in the project area would be buried. This would result in greater potential safety hazards caused by motorized and non-motorized use than under Alternative C, but fewer safety hazards than under the Proposed Action and Alternative B due to the removal of surface obstructions.

Potential impacts from the new Caprock Pipeline and maintenance of the existing Caprock pipelines would be the same as described in Alternative B. Pipelines would be installed under NM 360 at four locations and under U.S. 62/180 at three locations within the project area with little or no interruption of traffic during construction. Intrepid would be responsible for obtaining all permits and ROW authorizations from the appropriate agencies (the BLM or the State of New Mexico) or individual landowners to install the new Caprock pipeline.

4.10.9 Mitigation Measures

Additional mitigation measures are not needed.

4.10.10 Summary of Impacts

Impacts would be similar across all action alternatives, but slightly more under the Proposed Action and Alternative B, mainly due to the existence of the aboveground pipelines, which would require additional BLM enforcement and may result in constraints on other land uses for the life of the proposed project.

Because no additional mitigation measures are appropriate, the residual impacts would be the same as the direct and indirect impacts discussed under each alternative above.

4.11 Recreation

Primary recreational activities in this area are associated with hunting, hiking, and OHV use. The Hackberry SRMA receives the highest recreational use within the project boundary.

4.11.1 Issues

Recreation issues associated with the proposed project include:

- Concern for the effects on the use of recreation areas such as Hackberry SRMA (e.g., OHV use and access limited by aboveground pipelines, visibility of aboveground structures).
- Reduction in access to dispersed recreation activities such as hunting, biking, camping, off-highway driving, and special events on public lands.
- Pipeline ROWs and access roads may become unauthorized OHV routes.
- Subsidence may affect recreational uses in the project area.
- Reduction in recreational use of the area and tourism due to project-related traffic.

4.11.2 Method of Analysis

GIS analysis was used to identify the location and size of the SRMA that is within the project area boundary. Using GIS, the projected subsidence areas were overlaid on the SRMA to identify which areas might be affected.

4.11.3 Assumptions

Assumptions for analysis are as follows:

- Aboveground pipelines would limit access, as well as affect OHV use, and hunting quality and opportunities by altering normal traffic patterns for vehicles and wildlife.
- Impact analysis must be qualitative due to the lack of accurate recreation use numbers for the project area.

4.11.4 No Action Alternative

Under the No Action Alternative, in-situ mining activities and the associated new facilities would not be developed within the project area. Potash mining would continue with the current methods, and impacts to recreation would not change.

4.11.5 Alternative A—Proposed Action

Surface disturbance generated by construction would potentially affect recreation activities such as dispersed camping and hunting for big game, deer, dove, quail, and varmints. Construction activities would generate increased noise and traffic primarily during the day, which may temporarily diminish camping and hunting activities. The presence of new aboveground facilities also would potentially diminish the hunting experience by displacing habitat as well as increasing noise and human presence.

Increased project-related traffic on both access roads and BLM roads may tend to reduce tourism and recreational uses in the area. This impact is likely to be minor due to the users being accustomed to existing mineral development and operations within the project area.

The Hackberry SRMA receives the highest level of recreational use within the project area. Public access to this area may be impeded by increased project-related traffic, especially during construction. Also, increased vehicle and heavy equipment travel in the immediate area of the SRMA may pose a risk to OHV operators on access roads. Production facilities such as new roads, power lines, and pipelines can interrupt existing recreation trail use. They also can be a hazardous obstacle to OHV users traveling along trails. Pipelines would cross existing OHV trails approximately nine times. Two of these crossings would occur in the vicinity of HB South, three in HB North, and four adjacent to HB Crescent. The aboveground pipelines would present a risk to OHV use in the project area by obstructing OHV travel, but the planned burial of pipelines at designated locations would minimize impacts to OHV use and recreation.

Approximately 5 percent, of the Hackberry SRMA lies within the area of potential subsidence. Subsidence resulting from the Proposed Action is expected to be minimal, and is unlikely to affect recreational uses in the Hackberry SRMA because subsidence would be gradual. Uneven ground surface or open cracks in the surface that may result from subsidence may present a safety hazard to OHV riders, but this type of subsidence has already occurred in the project area without adverse effects to recreational users. Slightly changing the terrain may improve the OHV experience.

4.11.6 Alternative B

Under Alternative B, impacts would be the same as described for the Proposed Action in the project area. As a result of construction of either Caprock pipeline option, a temporary increase in construction vehicle traffic would extend into Lea County. This impact to recreational uses in the region would be minimal. All other potential impacts to recreation would be the same as under the Proposed Action.

4.11.7 Alternative C

Obstacles to OHV travel, hiking, or wildlife traffic caused by aboveground pipelines would not occur under this alternative, resulting in fewer impacts than under the Proposed Action. The projected impacts due to subsidence, increased public access on new access roads, and increased construction and operational vehicle traffic would be the same as that described for the Proposed Action.

4.11.8 Alternative D—Preferred Alternative

Under the Preferred Alternative, impacts in the project area would be similar to those described for Alternative C. With 68 percent of the all the pipelines in the project area buried under the Preferred Alternative, and all of the pipelines within the Hackberry SRMA buried, there would be fewer safety hazards for recreational vehicle users and fewer limitations on the development of new OHV trails. Therefore, there would be fewer long-term recreation impacts than under the Proposed Action and Alternative B.

4.11.9 Mitigation Measures

Mitigation measures that would minimize the impacts to recreational users include the following:

- If subsidence cracks that may affect riders and hikers occur, signage and trail maintenance should be implemented in affected areas.
- To minimize conflicts with recreational users, construction should not occur within the Hackberry Lake SRMA during the organized OHV event in September or on weekends during periods of active OHV use.
- Aboveground pipelines should be buried under trails to extend at least 20 feet on either side of the trail. Pipelines should be buried as soon as possible and visible signage should be placed on either end of the trail during construction to warn approaching riders.

4.11.10 Summary of Impacts

Under all alternatives except No Action, there would be an expanded road network within the project area, increased vehicle traffic, OHV safety concerns associated with subsidence and new structures, and an increased potential for unauthorized OHV use along new access roads. These impacts would decrease by the end of the proposed project, as facilities are decommissioned, portions of the project area are reclaimed, and new subsidence areas stabilize.

4.12 Visual Resources

4.12.1 Issues

- Changes in the landscape due to new surface pipelines, booster stations, and electrical connections.
- Consider impacts to foreground, middle ground, and background.
- Consider whether changes in scenery would impact the overall recreation experience by visually altering the natural environment.

4.12.2 Methods of Analysis

The visual quality of the scenic resource in the project area was rated by analyzing the relative worth of the affected landscape from a visual perception point of view. Key factors considered were landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications. The result of this rating for the project area was a Scenic Quality Classification of C, which is the lowest. This scenic quality classification was compared to an estimate of what the area would look like if the proposed facilities were built.

4.12.3 Assumptions

Assumptions for analysis are as follows:

- Any surface facility would potentially alter the viewshed. The degree of change would be based on line, form, color, and texture of the facility.
- All injection and extraction wells would not significantly alter the viewshed.
- Changes would be considered significant if alterations dominate the landscape.
- Impacts to visual resources would be minimized through implementation of the relevant BLM environmental protection measures.

4.12.4 No Action Alternative

Under the No Action Alternative, in-situ mining activities and the associated new facilities would not be developed within the project area. Potash mining would continue with the current methods, and changes to the viewshed would be consistent with the other structures and current land uses in the landscape.

4.12.5 Alternative A—Proposed Action

Impacts to the visual landscape from the implementation of the Proposed Action would result in slight to moderate modifications of the viewshed due to the addition of evaporation ponds, roads, aboveground pipelines, new mill, and well pads. The proposed evaporation ponds would be highly visible from Maroon Cliffs as well as the Hobbs Highway (U.S. 62/180). Long-term visible impacts would be caused by alteration of the landscape by man-made linear features that would add to the number of lines present in the landscape, mainly access roads and surface pipelines. These lines are not characteristic natural features, but they are currently present in the project area. A recent internal BLM report indicated the proposed project would not change the Scenic Quality classification of the project area.

Construction activities would potentially produce dust that may temporarily reduce visibility, but this would be minimized if a dust control plan were implemented, as recommended in Section 4.5.8, Air Quality.

4.12.6 Alternative B

Under Alternative B, impacts in the project area would be the same as that described for the Proposed Action. In order to provide more water from existing wells, Intrepid would either build a single new Caprock pipeline or would replace existing buried Caprock pipelines within the same ROWs. There would be additional temporary impacts to visual resources due to the visibility of the installation or replacement of the Caprock pipelines. As reclamation and revegetation of the disturbed areas progresses, the disturbance along the Caprock pipelines would fade into the background.

4.12.7 Alternative C

Under Alternative C, all pipelines would be buried, resulting in fewer impacts that are visible on the land surface. As reclamation and revegetation of the disturbed areas progresses, the disturbance along the buried pipelines would fade into the background. The proposed surface structures would still be constructed; however, due to the burial of the pipelines there would be fewer changes to the viewshed than under the Proposed Action over the long term.

4.12.8 Alternative D—Preferred Alternative

Under the Preferred Alternative, impacts in the project area would be similar to those described for Alternative C. Burial of 68 percent of the proposed pipelines in the project area would result in greater long-term visual impacts than under Alternative C, but fewer long-term visual impacts than the that described for the Proposed Action and Alternative B. Potential visual impacts from the new Caprock pipeline and maintenance of the existing Caprock pipelines would be the same as described for Alternative B.

4.12.9 Mitigation Measures

No additional mitigation measures are needed beyond the BLM environmental protection measures summarized in **Table 2-9** and described in more detail in **Appendix B**.

4.12.10 Summary of Impacts

Under all alternatives, the visible impacts would be mainly from alteration of the landscape by man-made features creating lines and pools of water not previously present in the landscape. With the exception of the evaporation ponds, similar man-made features currently exist in the project area. Intrepid would comply with BLM visual resource management requirements to minimize impacts. Impacts are not expected to be incompatible with current BLM VRM objectives.

4.13 Cultural Resources

4.13.1 Issues

Primary issues of concern include actions that result in adverse effects to properties listed or eligible for listing on the NRHP or considered important to Native American groups. These actions include:

- Ground-disturbing activities
- Subsidence
- Erosion
- Illegal collection of artifacts
- Vandalism
- Unanticipated discoveries

4.13.2 Methods of Analysis

Analysis of impacts to cultural resources was performed by reviewing reports of cultural resource investigations that have been completed in the project area, some of which were conducted for Intrepid specifically for the proposed project.

4.13.3 Assumptions

- Class III field inventories will be conducted for all proposed disturbance areas prior to construction.
- Cultural resource protection and mitigation will be in accordance with the terms of the Protocol Agreement. On state land, cultural resource protection and mitigation will be in accordance with the New Mexico Cultural Properties Act, as amended (NMSA 1978, §§18-6-1 through 18-6-17).
- Resources or sites of tribal concern will be protected in accordance with tribal consultation requirements and other federal regulations.
- Where avoidance is not possible, mitigation measures will be developed based on the Protocol Agreement.
- The BLM will continue tribal consultation throughout the environmental review and construction phase of the proposed project, if approved. Renewed contacts with some or all of the tribes may result from unanticipated discoveries.

4.13.4 No Action Alternative

Under the No Action Alternative, the project would not be approved and the existing potash leases would not be modified. Current land and resource uses would continue under current conditions in the project area. No additional ground-disturbing activities beyond those currently authorized would occur in the project area. Prior to construction of the authorized facilities, adverse effects to NRHP eligible sites located in the area of the facilities would be fully mitigated in accordance with the Protocol Agreement. Therefore, no effects to NRHP-eligible sites are anticipated under the No Action Alternative.

4.13.5 Alternative A—Proposed Action

Section 106 of the NHPA requires that federal agencies take into account the effect of an undertaking on historic properties and provide the ACHP an opportunity to comment. Historic property, as defined by the regulations that implement Section 106, means “any prehistoric or historic district, site, building, structure, or object included, or eligible for inclusion, in the NRHP maintained by the NPS.” The term includes properties of traditional religious and cultural importance to any Native American tribe or Native Hawaiian organization that meet the National Register criteria.

Potential impacts to NRHP-eligible sites are assessed using the “criteria of adverse effect” (36 CFR 800.5[a][1]): “An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling, or association.” There are five broad categories of effect:

1) Physical destruction or alteration of a property or relocation from its historic location;
2) Isolation or restriction of access;
3) Change in the character of the property’s use or of physical features within the property’s setting, or the introduction of visible, audible, or atmospheric elements that are out of character with the significant historic features of the property;
4) Neglect that leads to deterioration or vandalism; and

5) Transfer, sale, or lease from federal to non-federal control, without adequate and legally enforceable restrictions or conditions to ensure the preservation of the historic significance of the property.

Under NEPA, effects to NRHP-eligible sites can be direct or indirect. Direct effects are caused by an undertaking and occur at the same time and place (40 CFR 1508.8[a]). These types of effects to NRHP-eligible sites include physical damage resulting from surface-disturbing activities and can occur to both known sites and subsurface sites. Indirect effects are caused by an undertaking and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). These types of effects often are not quantifiable and can occur both within and outside of the APE. Indirect effects to NRHP-eligible sites include, but are not limited to, changes in erosion patterns due to construction activities, inadvertent damage due to off-road maintenance traffic, and illegal artifact collection due to increased access to an area.

4.13.5.1 Potential Effects

Although effects to NRHP-eligible sites are determined on a site-specific basis, certain activities that are associated with the Proposed Action have a greater potential to adversely affect these sites than do others. Ground-disturbance associated with construction of the processing mill, well pads, utility conveyances, evaporation ponds, access roads, and water pipelines could result in direct effects to NRHP-eligible sites. These effects could result in the vertical and horizontal displacement of soil containing cultural materials and the resulting loss of integrity, loss of information, and the alteration of a site's setting.

Potential indirect effects to NRHP-eligible sites located within or outside of the project APE could include erosional effects from runoff or mine water discharge, off-road travel associated with construction and maintenance activities, and illegal collection, inadvertent damage, and vandalism due to increases in both surface disturbance and the number of people in the project area. Other potential indirect effects could include subsidence as a result of mineral extraction. Subsidence could damage archaeological sites, affect the stratigraphic integrity of buried archaeological deposits, and adversely affect the integrity of a site's setting. In addition, subsidence could affect surface drainage flow resulting in erosional impacts to surface and subsurface archaeological sites. Erosion and subsequent redeposition can produce a secondary deposit of archaeological material that contains no contextual integrity. The reader is referred to Section 4.2, Geology and Minerals, for a detailed discussion of the potential for subsidence to occur as a result of the proposed project.

The potential for the discovery of unanticipated archaeological deposits during construction activities exists within proposed disturbance areas and could result in direct effects. Unanticipated discoveries could result in displacement or loss (either complete or partial) of the discovered material. Displacement of archaeological deposits affects the potential to understand the context of the site and limits the ability to extrapolate data regarding prehistoric settlement and subsistence patterns.

The Proposed Action may result in the loss of archaeological sites that are not eligible for the NRHP through surface-disturbing activities during construction. These sites would be recorded to BLM standards and the information integrated into local and statewide databases.

4.13.5.2 Resolution of Effects

At this time, no Class III inventories have been conducted for the proposed locations of the mill processing facilities, water pipelines, and utility conveyances associated with the proposed project; all other proposed project components have been inventoried. Inventories of proposed project components not yet inventoried would be completed prior to project construction. Evaluative testing at three NRHP-eligible prehistoric sites located during previous inventories was completed in late fall 2009. Laboratory analysis of the data collected during testing currently is ongoing. Results of the testing and laboratory analysis will determine the need for additional archaeological work (e.g., data recovery) at these sites.

Avoidance would be recommended for NRHP-eligible sites that may be located during the remaining Class III inventories of the mill processing facilities, water pipelines, and utility conveyances. If avoidance is not possible, the BLM would determine whether construction of the proposed project would have an adverse effect on these sites. If the BLM determines that the sites would be adversely affected, then mitigation would be proposed in accordance with the Protocol Agreement. Potential indirect effects to NRHP-eligible sites located within and outside of the APE as a result of runoff or water discharge are anticipated to be minor based on the surface water control system and implementation of erosion control measures required under the NPDES permit. In compliance with the applicant-committed environmental protection measures, vehicle access would utilize existing roads to reduce the potential for indirect impacts associated with off-road vehicle travel during construction and maintenance activities. To minimize the potential for illegal collection of artifacts, vandalism, and inadvertent damage, the project proponent and their construction supervisor would inform all employees and subcontractors that archaeological sites are to be avoided by all personnel, vehicles, and equipment, and that it is illegal to collect, damage, or disturb cultural resources on federal land.

To minimize potential impacts associated with subsidence, Intrepid installed survey monuments to monitor subsidence over the 25-year life of their proposed in-situ solution mine. The project consisted of setting approximately 75 monuments at just aboveground level along 5 transects. Measurements would be made at each station approximately twice a year for up to 25 years. A Class III cultural resource inventory was conducted in conjunction with the surveying of the route and placement of the monuments. All NRHP-eligible sites were avoided during installation of the monuments. See Section 4.2, Geology and Minerals, for an expanded discussion of the subsidence monitoring program and its potential to reduce subsidence impacts in the future.

As provided in the applicant-committed environmental protection measures, if any previously unknown archaeological sites are discovered during construction on BLM-administered lands, all construction activities would cease in the area of the discovery, and the BLM Authorized Officer would be notified of the find. Steps would be taken to protect the site from vandalism or further damage, such as fencing or other security measures, until the BLM Authorized Officer could evaluate the nature of the discovery. Effects to NRHP-eligible sites discovered during construction would be mitigated through data recovery per the Protocol Agreement. If construction or other project personnel discover what might be human remains, funerary objects, or items of cultural patrimony on federal land, then construction would cease in the area of the discovery, and the BLM Authorized Officer and local BLM law enforcement officer would be notified of the find within 24 hours. Steps would be taken to protect the remains from vandalism or further damage, such as fencing or other security measures. Any discovered Native American human remains, funerary objects, or items of cultural patrimony found on federal land would be handled in accordance with the NAGPRA.

If human remains and associated funerary objects are discovered on private or state land during construction activities, construction would cease within the area of the discovery and the county coroner or sheriff would be notified of the find. Treatment of any discovered human remains and associated funerary objects found on private or state land would be handled in accordance with the provisions of the New Mexico Cultural Properties Act, as amended (NMSA 1978, §18-6-11.2).

4.13.6 Alternative B

Alternative B would include all of the facilities described for Alternative A (Proposed Action) with the exception of the northernmost Rustler wells and pipelines, which would not be included under this alternative. Intrepid's existing pipelines from the Caprock well fields would be replaced with new pipe within the same ROWs to transport the water to the project area. Replacement of the existing buried concrete pipelines would result in more ground disturbance compared to the Proposed Action. More ground disturbance would increase the potential for direct impacts to cultural resources that may be eligible for the NRHP. Class III cultural resources inventories of the water pipelines would be required prior to ground disturbance. If NRHP-eligible sites are located during the inventories and cannot be avoided, potential impacts would be mitigated as described above for the Proposed Action.

Another possible option under Alternative B is to install a new Caprock pipeline to provide supplemental project water. Class III inventories would be required along the entire proposed new pipeline route prior to pipeline construction. If NRHP-eligible sites are located during the inventories and cannot be avoided, potential impacts would be mitigated as described above for the Proposed Action.

4.13.7 Alternative C

Under Alternative C, Intrepid's proposal would be modified to bury all of the water pipelines in the project area. The layout of the pipeline system would be the same as described for Alternative A (see Section 2.4.2, Alternative A—Proposed Action). More excavation would be required to bury the pipelines but the total acreage of surface disturbance would be the same as the Proposed Action due to clearing of vegetation and grading required within the ROWs. Additional excavation would increase the potential to discover and impact buried cultural remains. Class III inventories of the water pipelines would be conducted prior to ground-disturbing activities. Mitigation of potential impacts would be the same as described for the Proposed Action.

4.13.8 Alternative D—Preferred Alternative

In terms of surface disturbance, impacts to cultural resources under the Preferred Alternative essentially would be the same as Alternative B. Class III inventories would be conducted for all areas not previously inventoried prior to the start of surface-disturbing activities. If NRHP-eligible sites are located during the inventories and cannot be avoided by project construction, potential impacts would be mitigated as described for the Proposed Action.

4.13.9 Mitigation Measures

The following mitigation measures should be implemented:

- One NRHP-eligible prehistoric lithic, ceramic, and groundstone scatter was located near a proposed well location. Although no additional investigation of the site is necessary, an archaeological monitor is recommended during project construction to protect the site from potential damage. Project construction should not begin prior to arrival of the monitor.
- To protect NRHP-eligible sites located adjacent to project construction, fencing should be erected between the site and construction activities.
- A BLM-approved archaeological monitor would monitor project construction in areas with the potential for buried cultural remains. The BLM would determine which areas require a monitor. Project construction should not begin prior to arrival of the monitor.

4.13.10 Summary of Impacts

The Proposed Action and Alternatives B and C may result in the loss of archaeological sites that are not eligible for the NRHP. Although these sites would be recorded to BLM standards and the information integrated into local and statewide databases, the sites ultimately would be destroyed by project construction. Ineligible sites have no legal protection and their destruction is not generally considered an adverse impact.

NRHP-eligible sites identified within proposed disturbance areas would be avoided or, if avoidance is not possible, mitigated in accordance with the NHPA. Although NRHP-eligible sites would be mitigated through implementation of data recovery, some of the cultural value associated with these sites cannot be fully mitigated; therefore, it is anticipated that residual impacts to these resources would occur.

Indirect effects, such as illegal collecting of artifacts, have occurred and most likely would continue to occur in the project area through increased access, development, and increased human presence, as a result of past, present, and reasonably foreseeable future actions.

4.14 Hazardous Materials, Health and Safety

4.14.1 Issues

Hazardous materials, health, and safety issues associated with the proposed project include:

- The potential for a spill to contaminate water and soil resources.
- The potential for a spill to harm employees and members of the public at the spill site.
- Unauthorized personnel entering areas where active mining operations are taking place.
- Public endangerment from subsidence.
- Increased traffic on local and area roads.

4.14.2 Method of Analysis

The mine plan and other relevant documents were reviewed to determine how hazardous materials and solid wastes are currently handled at Intrepid plants in the region and how they would be handled if the proposed project were approved. The potential risk for contamination of soil and water resources from spillage or improper disposal was determined qualitatively based on existing plans.

4.14.3 Assumptions

Assumptions for analysis are as follows:

- Intrepid will draft a project-specific emergency response plan.
- Employees will be trained in safety procedures and will be expected to follow all established safety procedures.
- Intrepid will draft a project-specific SPCC Plan.
- If some of the chemicals identified for use during the life of the proposed expansion were to enter the environment in an uncontrolled manner, there could be associated direct or indirect adverse effects.

4.14.4 No Action Alternative

Under the No Action Alternative, in-situ mining activities would not take place within the project area. Existing emergency response and spill plans for current potash mining operations would continue to be implemented.

4.14.5 Alternative A—Proposed Action

Under the Proposed Action, the transport, storage, use, and disposal of hazardous materials for mine operations would continue for the 28-year life of the project and through site closure and reclamation.

4.14.5.1 Health and Safety

Precautions would be taken to ensure the health and safety of the public as well as mine employees. A controlled entrance to the mine site would allow access to only authorized personnel. The new HB mill would be fenced to protect against vandalism and to protect against the entrance of unauthorized personnel. Intrepid employees would be required to take multiple forms of safety training and adhere to safety regulations.

Because subsidence related to the Proposed Action is projected to be minimal, it would most likely not be a health and safety concern to land users, particularly in the Hackberry SRMA. Aboveground pipelines may present a public health and safety threat to OHV users, and may require increased BLM signage and possibly enforcement. In the Hackberry SRMA, pipelines would be buried at designated locations to minimize health and safety impacts.

Increased traffic would occur as a result of construction and operations potentially resulting in a health and safety risk; however, it is anticipated that the increase in traffic would not greatly affect normal traffic levels.

4.14.5.2 Hazardous Materials

Storage and Use

Intrepid has SPCC plans for existing operations at the West, East, and North plants. These plans are in compliance with 40 CFR Part 112, which describes the required level of containment and safety measures associated with storage, handling, and spill clean-up of oil, including but not limited to petroleum, fuels, sludge, used oil, and mineral oil (Intrepid Potash, Inc. 2010d). A similar SPCC Plan would be prepared for the in-situ solution mine operations and new HB mill. Operations conducted in accordance with the SPCC Plan would ensure that impacts from spills would be minimized and the spilled materials would be contained and removed. Intrepid would have the necessary spill containment and cleanup equipment available at the site, and personnel would be able to quickly respond.

All hazardous substances would be handled in accordance with applicable MSHA regulations (Title 30 CFR). The hazardous materials to be used under the Proposed Action would be handled as recommended on the manufacturer's Material Safety Data Sheets. Based on the facility's design features and the operational practices in place, the probability of a major release occurring at the site during the life of the proposed solution mine project would be low.

Disposal

All hazardous waste generated at the mine would be transported to licensed disposal facilities in accordance with applicable federal and state regulations. Other solid wastes would be disposed of appropriately depending upon waste type.

Potential Effects of a Release

The environmental effects of a release would depend on the material released, the quantity released, and the location of the release. Potential releases could include a small amount of diesel fuel spilled during transfer operations at the mine site to the loss of several thousand gallons of diesel fuel or reagent into a riparian drainage.

The release of a hazardous material or waste into a sensitive area such as stream, wetland, or populated area is judged to be very unlikely. Depending on the material released, the amount released, and the location of the release, an accident resulting in a release could adversely affect soils, water, biological resources, and human health.

Response to a Release

All spills, including transportation and loading/unloading spills occurring on site, would be cleaned up as soon as possible. If a spill exceeds the reportable quantity, it would be reported to the New Mexico Environment Department, USEPA, National Response Center, and the BLM.

In the event of a release on the way to the facilities in the project area, the transportation company would be responsible for response and cleanup. Law enforcement and fire protection agencies also may be involved to initially secure the site and protect public safety. Hazardous materials transporters are required to maintain an emergency response plan, which details the appropriate response, treatment, and cleanup for a material spilled onto land or into water.

For on-site spills, the procedures outlined in the SPCC Plan would be used to respond to petroleum and fuel spills. Specific procedures would be developed for other hazardous materials to stored and used at the mine and the mill. Any cleanup would be followed by appropriate restoration of the disturbed area, which could include replacing removed soil, seeding the area to minimize erosion, and the return of the land to its previous use.

4.14.6 Alternative B

There would be no difference in health and safety concerns or hazardous materials use and solid waste generation under this alternative as compared to the Proposed Action. Therefore, the potential impacts would be the same as described for the Proposed Action.

4.14.7 Alternative C

There would be no difference in health and safety concerns or hazardous materials use and solid waste generation under this alternative as compared to the Proposed Action. Therefore, the potential impacts would be the same as described for the Proposed Action.

4.14.8 Alternative D—Preferred Alternative

There would be no difference in health and safety concerns or hazardous materials use and solid waste generation under this alternative as compared to the Proposed Action. Therefore, the potential impacts would be the same as described for the Proposed Action.

4.14.9 Mitigation Measures

A project-specific emergency response plan should be prepared for the new HB mill and in-situ solution mining operations.

4.14.10 Summary of Impacts

Effects from the use of hazardous materials under the all action alternatives would depend on the substance, quantity, timing, location, and response involved in the event of an accidental spill or release. Operation in compliance with applicable regulations and in accordance with the facility's SPCC Plan, and the prompt cleanup of potential spills and releases would minimize the potential for impacts under all alternatives.

4.15 Socioeconomics and Environmental Justice

4.15.1 Issues

The primary issues associated with socioeconomic resources include direct or indirect impacts to the local economy in terms of jobs, local labor markets and income, effects on other economic activities, population trends and migration, housing markets, public facilities and services, public sector fiscal resources, and social conditions in the region. Short and long-term effects would result from the temporary construction and long-term operating jobs associated with the proposed In-situ Solution Mine Project and the capital investments made by the applicant. Indirect socioeconomic effects would arise from the incremental demands for goods and services and circulation of money in the region supported by the direct jobs and investments.

4.15.2 Method of Analysis

The assessment process of project-induced effects on social and economic values included review and analysis of existing conditions and trends in population and demographics, migration, economic activity, employment, labor force participation, earnings and income, poverty, land use, housing, local government facilities, services and fiscal conditions, social structure and attitudes and opinions. Information was compiled from available secondary sources, augmented by interviews with local officials and residents. Additional information for the social assessment was obtained from BLM scoping documents and attendance at scoping and other public meetings.

For the assessment of effects of construction and operations of the proposed surface facilities, evaporation ponds, and mill, potential social and economic effects were identified by review and extrapolation of information contained in Intrepid's plan of development, and by considering the location and timing of work force and construction activities in the context of existing social and economic conditions and community and housing capacities. This portion of the assessment was informed by community experience with other natural resource development and construction projects, both within the project area and in other locations. Potential revenues associated with the construction and operations of the HB In-Situ Solution Mine Project were considered for their potential to offset public costs of providing goods and services to the construction and operations work forces.

For this assessment, estimated employment and payroll provided by the applicant were the primary inputs for a regional economic assessment process using the IMPLAN economic modeling software. IMPLAN is an input-output based model originally developed to assist the USFS in land resource management planning. Subsequently, the model and related software were transferred into the private sector, where it is the subject of ongoing refinement and enhancements to provide the analytical capacity to address a broader range of economic and impact planning issues. IMPLAN is widely recognized and accepted in regional economic and economic impact assessment circles. The model maps the flow of dollars through the region's economy and provides information about the interaction of individual sectors within the regional economy. The model considers both the direct effects on the producing sector(s) of a change in economic activity and the secondary effects on other local sectors due to the linkages within the region's economy. The model is widely used for NEPA assessments and BLM planning initiatives across the west.

IMPLAN assumes that current relationships between sectors will remain similar in the future. The model does not consider potential changes in other sectors of the economy unless they also are specified as inputs. For this assessment, only the economic activity associated with the Proposed Action was considered in the IMPLAN modeling process. As noted below, the activities associated with the Proposed Action have the potential to have minor adverse effects on other economic activities such as grazing and outdoor recreation within the planning area. These potential effects are not addressed within the IMPLAN modeling process but are discussed in the following sections.

Applicant committed measures, and BLM regulations were taken into account in determining significant impacts.

4.15.3 Assumptions

The following criteria are used to determine whether socioeconomic impacts of the action alternatives and the No Action Alternative would be significant.

- An increase in county or community population that would strain the ability of affected communities to provide housing and services or otherwise adapt to growth-related social and economic changes.

- An aggregate change in public sector revenue and expenditure flows likely to result in an inability on the part of affected units of government to maintain public services and facilities at established service levels.
- Permanent displacement of residents or users of affected areas that would result from project-induced changes in or conflicts with existing uses or ways of life.
- Disproportionately high and adverse environmental or human health impacts to an identified minority or low-income population, which appreciably exceed those to the general population around the project area.

4.15.4 No Action Alternative

The No Action Alternative describes future conditions in the project area assuming denial of the requested ROWs for the proposed project. Denial would preclude Intrepid from recovering the mineral resource in the existing mine workings unless another practical method could be found to extract the resource. This would result in a foregone economic opportunity for the company, one having economic and social implications for the community and fiscal implications for federal, state and affected local governments—although the EIS only focuses on the more localized effects as an assessment of the broader implications is beyond the scope of this analysis.

From a social and economic perspective, the No Action Alternative represents a hypothetical "status quo" scenario in which the future unfolds absent the discrete actions and effects associated with Intrepid's HB In-Situ Solution Mine Project. Essentially, the No Action Alternative assumes continuation of the existing economic drivers and influences affecting Eddy County, Carlsbad, and surrounding region. These include, but are not limited to the following:

- Potash production from Intrepid's currently permitted West Mine and East Mine operations
- Oil and gas development, maintaining the historical average rate of 75 new wells per year
- Operation of the Federal Law Enforcement Training Center
- Long-term operation of the WIPP
- Seasonal tourism and recreation, the former being anchored by Carlsbad Caverns and Guadalupe Mountains National Parks
- Louisiana Energy Services National Enrichment Facility
- Lifestyle migration

However, it also acknowledges uncertainties introduced by currently unknown factors and events that could exert even greater influences on growth and development in the assessment area over the long term. Perspectives regarding those influences may vary widely among individuals, groups, and organizations.

4.15.4.1 Economic Effects

Continuation of the key economic drivers listed above would be anticipated to sustain the region's economy for the foreseeable future, providing a relative high degree of economic vitality and diversity for its residents and a fiscal foundation for local government. Factors that potentially could support future growth include a higher pace of lifestyle migration, which could trigger a resumption of residential construction, and an increase in the pace of oil and gas development in the region.

Intrepid's current operations include approximately 629 employees (October 2009), substantial investment in plant and equipment and annual production capacity in excess of 850,000 tons of potash and langbeinite. Current estimates of proven and probable reserves support remaining life of mine forecasts of 120 to 130 years for the existing West Mine and 43 to 57 years for the East Mine (Intrepid Potash Inc. 2009).

The No Action Alternative would be subject to the restrictions and requirements of the 1986 Order (*Federal Register* 1986) and OCC Order R-111-P. Oil and gas development and its associated local employment, income, and economic activities are contingent upon future permitting and environmental compliance and on energy prices to support such activity, particularly given the environmental and safety constraints and concerns associated with potash mining areas. The No Action Alternative would effectively preclude extraction of potash from the inactive workings, absent some other practical recovery method.

4.15.4.2 Population and Demographics

Population projections prepared by the UNM-BBER in 2008 anticipate moderate long-term growth for Eddy County, with net growth of nearly 7,500 residents projected between 2010 and 2035 (UNM-BBER 2008). The rate of projected growth in Eddy County is considerably lower than forecasts for the Albuquerque metropolitan area, but higher than most rural areas of the state.

4.15.4.3 Housing

The No Action Alternative would not affect housing in the analysis area. Anticipated baseline population growth would require additional long-term residential development, but such development is consistent with the long-term plans adopted by local governments.

4.15.4.4 Public Infrastructure, Services, and Local Government Fiscal Conditions

Eddy County, local municipal governments and school districts engage in long-term planning efforts intended to prepare for growth and economic development. These efforts, and the plans that result, establish the groundwork for capital improvement programs and provision of public facilities and services in a fiscally responsible manner. The Eddy County Comprehensive Plan, last updated in 2008 (Eddy County 2008), and the Greater Carlsbad Housing Analysis and Strategic Plan (City of Carlsbad 2009) are both predicated on long-term growth. Supporting the existing potash mining and oil and gas industries and their role in the region's economic, social, and fiscal framework is consistent with the achievement of such growth. So too is the pursuit of further long-term economic growth and diversification. Implementation of the No Action Alternative would avoid the short- and long-term demands associated with the project-related incremental growth, but also an incremental increase in public sector revenues. The magnitude, timing, and net implications of the future demands and growth are uncertain.

4.15.4.5 Social Organization and Conditions

Current social conditions and trends in the analysis area would be unaffected by implementation of the No Action Alternative. Potentially affected groups including grazing operators, hunters, and OHV users of the project area would similarly not be affected. Oil and gas operators with current, historical, and potential future interests within the project area would likely be satisfied with implementation of the No Action Alternative.

Implementation of the No Action Alternative would effectively eliminate a source of concern about potential increased subsidence associated with the injection of water into subsurface formations for some Eddy County residents.

4.15.4.6 Environmental Justice

The continuation of current economic activities and social trends under the No Action Alternative would not be anticipated to result in any disproportionately high adverse human health and environmental effects on minority or low-income populations in the region. Consequently, environmental justice concerns would not be expected under the No Action Alternative.

4.15.5 Proposed Action

Implementation of the Proposed Action would involve short-term construction of proposed improvements over a 14- to-18-month period, followed by a 28-year operations period during which flooding and subsequent pumping of underground workings, evaporation, and mineral precipitation, and final processing would occur. Intrepid estimates additional investment of $120 million to $130 million to implement the Proposed Action, with ongoing production costs of between $11.4 million and $13.9 million during a typical year. Reclamation would follow the completion of production. The social and economic effects described below would be incremental effects to those associated with Intrepid's current operations.

4.15.5.1 Economic Effects

Relocation of existing power, natural gas, and fiber optic lines, development of evaporation ponds, construction of a new mill, and work to put additional water pumps, transmission lines and other support facilities in place will support short-term construction related jobs in the local economy, both directly and indirectly. Project timetable and direct employment estimates provided by Intrepid call for 91 jobs during the initial quarter of construction activity. Thereafter direct employment increases to an anticipated peak of 274 jobs, primarily in conjunction with construction of the new mill and evaporation ponds. Employment would remain at approximately the same level for a year until construction is substantially completed, declining to about 20 jobs to finalize completion of the evaporation ponds (**Figure 4.15-1**) (Intrepid Potash Inc. 2011).[1]

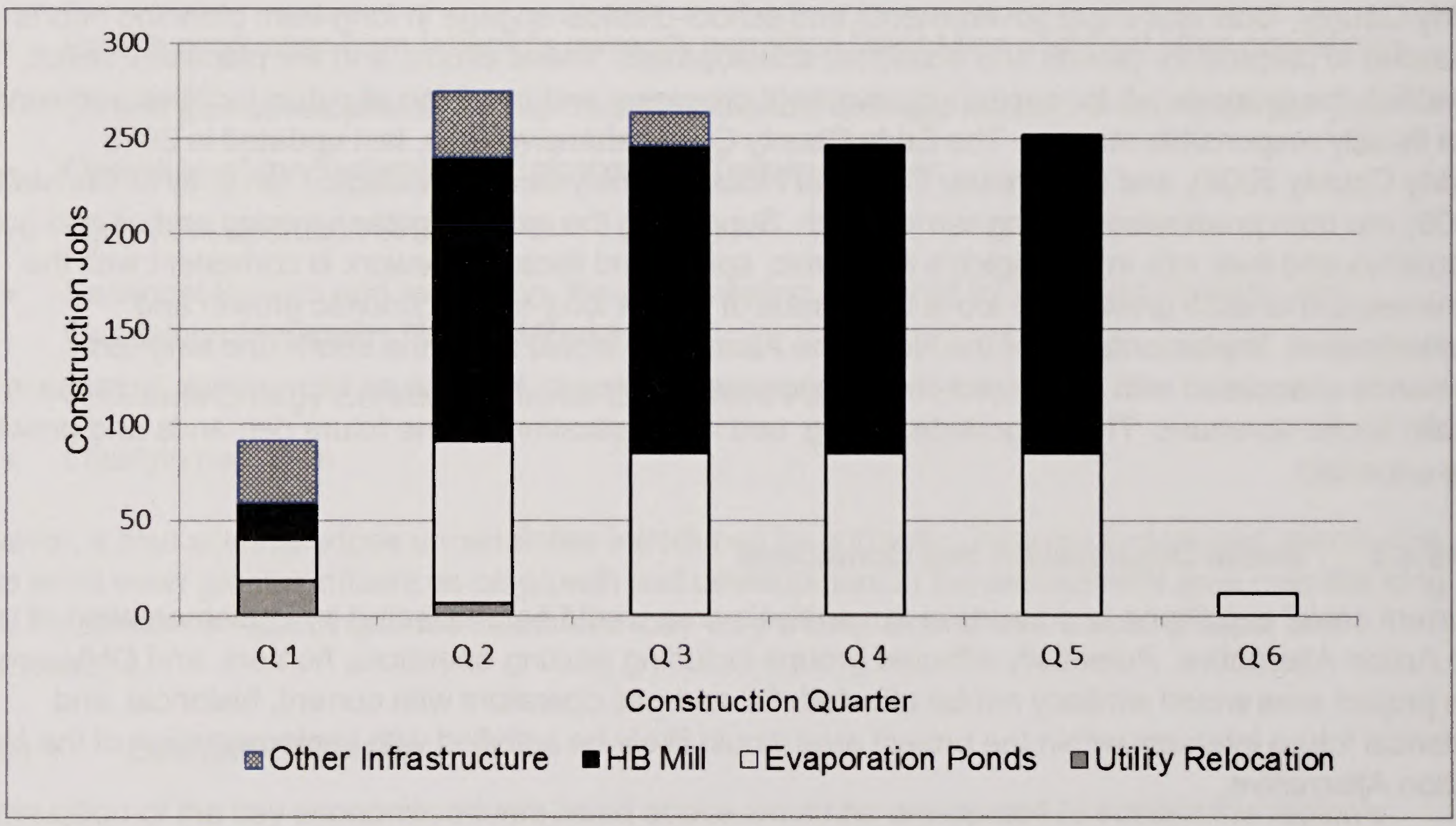


Figure 4.15-1 HB In-Situ Project Estimated Direct Construction Jobs

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[1] Further perspectives on the potential economic impacts associated with the proposed project can be found in "The Economic Impacts of Intrepid Potash, Inc.'s Proposed HB Solar Solution Mine Project in Eddy County, New Mexico", 2011. The report was prepared by J. Peach, et al, at the Arrowhead Center, New Mexico State University under contract to Intrepid Potash, Inc.

Intrepid anticipates expanding its existing operational work force of 629 employees (October 2009) by 36 positions in conjunction with the Proposed Action. Hiring for operations would likely begin in the latter stages of construction, with the added jobs continuing over the 28-year anticipated productive life of the In-Situ Project. Reclamation following the completion of production would provide an unspecified number of short-term jobs.

Through a process commonly known as the "economic multiplier," purchases of machinery, equipment, and supplies by Intrepid Potash and its contractors, along with purchases of goods and services by the company's employees and those of its contractors would indirectly support other jobs in the surrounding economy. Based on the size and composition of the current economy and the industrial linkages between the mining industry and other sectors of the economy, the IMPLAN model estimates that an additional 74 jobs are supported in the regional economy for every 100 construction jobs and associated investment. The IMPLAN multiplier for operational jobs is 0.54 secondary jobs. Job multipliers in the mining industry are commonly higher than those associated with construction. In Eddy County the converse applies, apparently a reflection of the high capital investment associated with the new mill and the use of solar evaporation in the production process, rather than more technology intensive processes. The net results of the multiplier effect would be short-term support of an additional 68 jobs during the initial phase of construction, with the number increasing to an average of 194 jobs during the 12 months of highest construction activity.

The total short-term stimulus associated with the Proposed Action is estimated to be 179 jobs during the first quarter of construction activity, increasing to an average of 453 jobs during the subsequent 12 months of higher construction activity (see **Figure 4.15-2** and **Table 4.15-1**). The majority of these jobs would be based in Eddy County, although Lea County would likely realize some benefit from the jobs based on economic linkages to Eddy County and the fact that the jobs of some Lea County residents could be tied to the project and some temporary residents may seek temporary housing in Hobbs or elsewhere in Lea County.

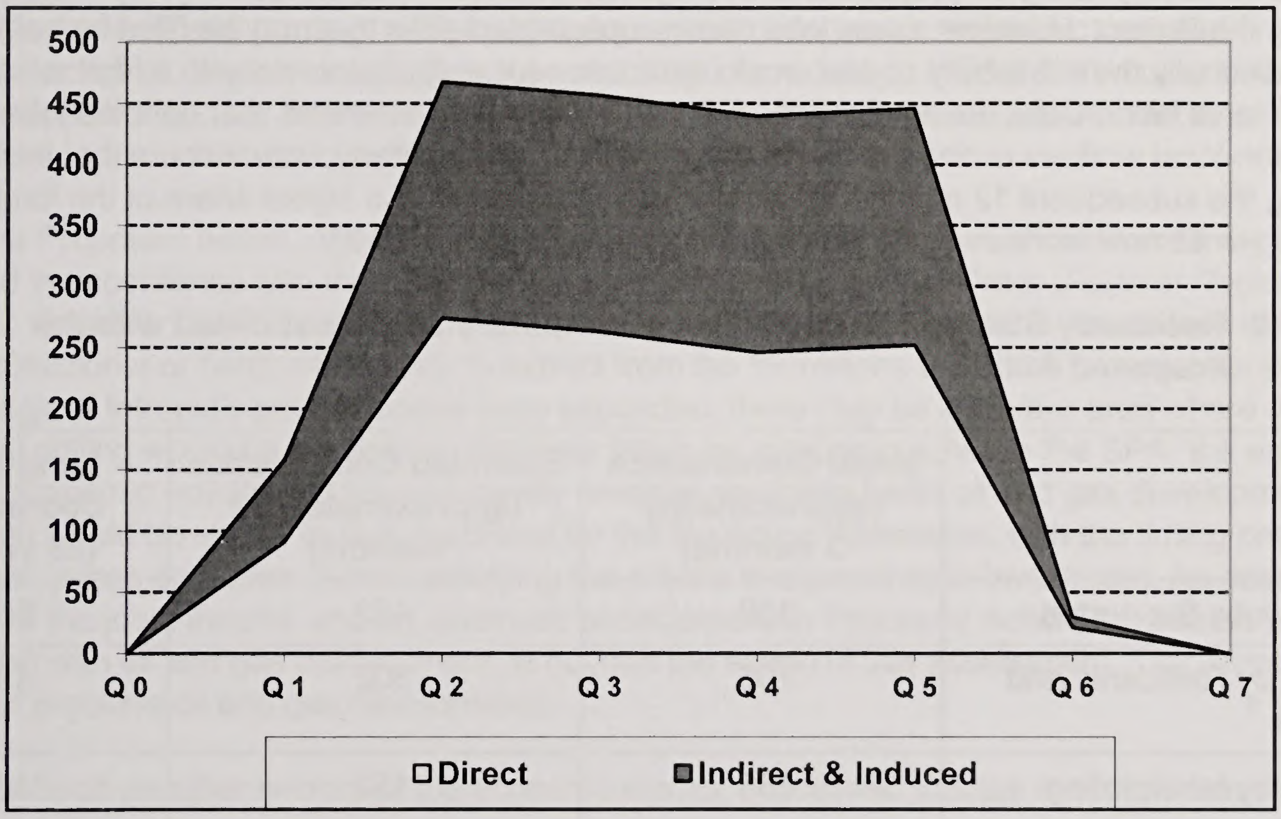

Figure 4.15-2 Total Temporary Employment Effects Associated With the HB In-Situ Project

Table 4.15-1 Total Employment Effects of the Proposed Action

	Initial Construction (approximately 3 months)	Extended Construction (approximately 12 months)	Long-term Operations (28 years)
Project Direct	91	259	36
Indirect and Induced [1]	68	194	19
Total New Jobs Supported	179	453	55

[1] Indirect and induced job multipliers are 0.75 per direct construction job and 0.54 per direct operations job, per IMPLAN model for Eddy County.

Following the completion of construction, the increase in operational employment at Intrepid would support an estimated 19 indirect and induced jobs elsewhere in the economy. The net result would be a net long-term beneficial effect of 55 jobs.

A relatively few direct and indirect jobs would be supported during final reclamation following the completion of production.

Construction and operations of the HB In-Situ Solution Mine Project would have a minor, but beneficial effect on local labor markets, increasing the number of job opportunities for residents and reducing unemployment. At the time of this assessment (third quarter of 2010) local unemployment was high and the local labor force included many skilled workers and candidates due to the relatively large size and established nature of the construction and mining industries in the economy. Consequently, current residents of the area, along with current residents of nearby Lea County who would commute and some non-local workers temporarily employed on other projects, are expected to fill the majority of the jobs supported by the Project. However, some jobs require specialized skills that may be filled by nonlocal workers. Additionally the availability of jobs would attract non-local applicants despite a high relative availability of local labor. Considering these factors, this assessment estimates that up to 53 jobs might be filled by non-local workers during the first quarter of construction activity, with that number increasing to 152 during the subsequent 12 months. Residents are expected to fill a higher share of the long-term jobs, resulting in 12 new workers in the local labor force (see **Table 4.15-2**).

Table 4.15-2 Residency Status of Workers Filling Temporary Jobs Associated with the Proposed Action

	Initial Construction (approximately 3 months)	Extended Construction (approximately 12 months)	Long-term Operations (28 years)
Total New Jobs Supported	159	453	55
Jobs Filled by Residents and Commuters [1]	106	302	43
Jobs Filled by In-migrating Workers	53	152	12

[1] Local residents and commuters are assumed to fill between 60 and 80 percent of the direct, indirect, and induced jobs supported by the proposed project.

The Proposed Action would result in beneficial short-term and long-term increases in personal income in the region. Jobs in the construction and mining industries are among the highest paying jobs in the local economy, thereby contributing to enhanced economic welfare for the directly affected households. The short-term direct increases, consisting of wages, salaries, and the value of benefits paid to construction workers are estimated at approximately $29.2 million; the majority accruing to local residents. Although much of the income accruing to non-residents would leave the region, the local economy would benefit from local purchases of goods and services made by non-local workers during their time of local tenancy. Personal income associated with the indirect and induced jobs supported by the construction phase of the project would contribute an estimated $9.3 million, resulting in a net increase of $38.5 million in personal income.

Small decreases in local farm and ranch income could result in conjunction with reductions in grazing associated with surface disturbance and changes in land use; such declines affecting a single or a few operators. Limited adverse effect on personal income could also result from project-related reductions in outdoor recreation, although it is possible that such activity would continue to occur but be displaced to other locations. The gains in personal income associated with the Proposed Action would greatly offset these declines on a net basis.

Long-term gains in labor income associated with operations of the HB In-Situ Project are estimated at $3.8 million per year, extending over the 28-year life of the project. Reclamation would generate additional short-term income in the future.

Implementation of the Proposed Action also would generate other short- and long-term economic benefits in the form of business revenues and profits, returns to shareholders of corporate entities, public sector revenues, investments in real estate and other infrastructure. The value of some of these benefits will extend beyond the life of the project.

Implementation of the Proposed Action would have limited and localized long-term adverse effects on grazing, OHV riding and hunting, marginally reducing the county-wide economic contributions associated with those activities. Furthermore, rather than resulting in a reduction in use, OHV riding and hunting may be displaced to other areas within Eddy County. The scale of these effects would be small in comparison to the economic benefits associated with the project.

Under the Proposed Action, oil and gas development within the project area would continue to be managed in accordance with the restrictions and requirements of 1986 Order (*Federal Register* 1986) and OCC Order R-111-P. This would mean that access to fluid minerals within the potash leases may require directional or horizontal drilling to extract from the formations under the potash-bearing strata. If the acreage of Intrepid's potash leases were expanded, there may be a greater area where directional or horizontal drilling would be necessary. Because this is an existing practice in the SPA, the employment, income, economic activity and tax and royalty revenue associated with oil and gas development and production would be similar to that described for the No Action Alternative, with the timing predicated on oil and gas prices and other factors satisfying the criteria to support such investment. An economic analysis of the jobs, income and tax revenues associated with Proposed Action, contrasted with those associated with oil and gas development, is beyond the scope of this assessment. The Proposed Action would not preclude oil and gas development.

Adverse effects on other sectors of the economy are not anticipated to arise in conjunction with the Proposed Action.

The economic infusion into the local economy associated with the Proposed Action represent long-term benefits of the project, contributing to the economic welfare of the region. The scale of these benefits would be minor in relation to the overall size of the regional economy.

4.15.5.2 Population and Demographics

A short-term population influx would occur in conjunction with work force migration to fill temporary direct, indirect, and induced job opportunities supported under the Proposed Action. The majority of nonlocal construction workers would be single status, although some workers may be accompanied by a spouse, partner, or families. Due to the temporary nature of the construction jobs under the Proposed Action, the number of families migrating into the area would be low, as would the number of school-age children.

The temporary population influx is estimated at up to 73 individuals during the first quarter of construction, climbing to a peak of 221 persons and an average of 210 persons during the subsequent 12 months of relatively stable activity, declining to 24 as construction is completed and the project transitions to long-term operation (**Table 4.15-3**). Some of the temporary workers may secure long-term jobs allowing them to remain in the region, but most would return to their permanent residence, or move on to another project when the project is completed.

Table 4.15-3 Short-Term Demographic Effects Associated with the Proposed Action

	Initial Construction (approximately 3 months)	Extended Construction (approximately 12 months)	Long-term Operations (28 years)
Jobs Filled by In-migrating Workers	53	152	12
Short-term Population Influx	73	210	24
School-age children	<5	8 to 10	4 to 6

The number of school-age children that entering local schools as a result of the Proposed Action is estimated at 10 or fewer during the construction period. Based on the proposed development schedule, some of those students could be mid-year transfers who then remain for a short period, i.e., through the end of the school year. The projected long-term population increment associated with implementation of Proposed Action is 24, 4 to 6 of whom could be school-age children.

Based on the 28-year production life of the project, some of the residents who migrate to the area to take production jobs may later choose to remain in the region following the cessation of production associated with the Proposed Action.

4.15.5.3 Housing

Based on the employment and population assessments described above, the Proposed Action would create demand for an estimated peak of 140 units and an average of 128 housing units for the 12-month period currently anticipated to begin in the fourth quarter of 2011. Approximately 59 percent of the average demand (75 units) would be associated with non-local single-status construction workers who temporarily migrate to the area. This demand is likely to be accommodated in hotels, motels, and RV parks, primarily in Carlsbad. The remaining incremental demand would be associated with construction workers who would expect to be on site throughout much of the overall construction period, for instance, construction management personnel or workers relocating to the area to accept indirect or induced jobs, and who are more likely to seek conventional housing such as single family rental homes or apartments.

Motel and RV park proprietors and other landlords would benefit from the Proposed Action-related demand, especially during seasonal periods of low tourism demand. Conversely, construction workers may compete with tourism and recreation visitors for temporary accommodations during peak tourism visitation months.

Some non-local workers also may seek housing in other communities such as Artesia, Loving, and Hobbs, but the number of such workers is anticipated to be relatively small based on the distribution of Intrepid's current work force (over 87 percent currently live in Carlsbad) and competition for housing from other sources, especially in Artesia.

Beginning in the sixth quarter of construction, total project-related demand would decline, eventually stabilizing at 10 conventional housing units. Even though moderate-priced conventional housing is in limited supply in Carlsbad, most workers should be able to secure housing over time given the relatively small number of units required and the relatively high wages associated with potash employment.

4.15.5.4 Public Infrastructure, Services, and Local Government Fiscal Conditions

Foreseeable effects on local government infrastructure and services are likely to be minimal given the estimated short- and long-term population influxes; a peak of approximately 221 temporary residents during the construction phase and an estimated 24 residents over the long term. Most temporary nonlocal workers would stay in existing temporary or conventional housing, which is already served by water, wastewater, and other utility infrastructure. The traffic and industrial activity associated with construction of the project may generate additional demand for Eddy County law enforcement, emergency response, and emergency medical services, but given the current level of mining and oil and gas activity near the project area, the incremental demand is anticipated to be relatively minor and similar in nature to existing demand.

The initial capital investment in facilities and equipment, ongoing value of that investment over time, other purchases of goods and services by Intrepid, its work force and that employed by its contractors, and sale of products associated with the Proposed Action would generate a series of one-time and recurrent revenues for the federal, state and local governments. These revenues would help sustain the existing fiscal structure of local public service providers.

The major revenue sources associated with the Proposed Action would include federal mineral royalties on the value of production and local ad valorem (property) taxes on the value of production and mining equipment and facilities. The state will realize an incremental gain in severance taxes, as well as deriving GRTs on the taxable value of goods and service purchases supported by the construction and operations of the Proposed Action. Local governments also would benefit from the increase in GRT.

- Federal mineral royalties: These royalties are determined by terms of specific lease agreements covering the mined area, resource grade/quality, and the value of production. Intrepid estimated the applicable average royalty rate for the Proposed Action at 4.2 percent. Implementation of the Proposed Action would yield average annual federal mineral royalties of between $2.3 million and $4.7 million, based on anticipated average annual sales of 185,000 tpy and historical range in sales price of $300 to $600 per ton. Taxable values are a function of both production and commodity prices and therefore subject to substantial year-to-year fluctuation (New Mexico Taxation and Revenue Department 2009; New Mexico Department of Finance and Administration 2009). The federal government would retain just over half (51 percent) of the receipts, the remainder would be disbursed to the state. The funds received by the state accrue primarily to the general fund, with subsequent disbursements to public education and other programs.
- New Mexico severance tax: Receipts are based on an initial assessment rate of 33.33 percent, from which royalties and a 50 percent standard deduction are subtracted, the residual being the taxable value, to which a tax rate of 2.5 percent is applied. The incremental receipts of severance taxes, based on anticipated production and range of market values, are between $172,975 and $345,950, over the long-term operational life of the project (Intrepid 2009). Severance tax receipts are first used for debt service on bonds issued by the state, with any remainder accruing to the severance tax permanent fund.

- Local ad valorem/property taxes: Assuming a taxable value of 50 percent of gross revenues from previous year's sales and a tax rate of 0.019, implementation of the Proposed Action is projected to yield between $0.53 million and $1.05 million annually, based on anticipated production and range of market values. Additional revenues would be derived on assessments on mining equipment and facilities, as well as off-site real estate improvements elsewhere in the community that are indirectly supported by the project.
- Gross receipts taxes: The GRT is levied on business receipts from sales and leases of most goods, property, and services. The combined tax rate in Eddy County, including local option taxes levied by the county and municipality and the state levy of 5.125 percent, ranges from 5.75 percent to 7.4375 percent. (New Mexico Taxation and Revenue Department 2009). Intrepid has secured Industrial Revenue Bonds through Eddy County that would qualify up to $60 million in qualified capital equipment from GRT. GRT would be generated on capital outlays in excess of that amount, as well as ongoing purchases during operations, and purchases made by individuals employed by contractors, Intrepid and other local businesses and public sector entities in conjunction with the Proposed Action. Due to the many factors underlying the local accrual of GRT, such receipts are not estimated as part of this assessment, though they are likely to be substantial. An economic impact analysis of the proposed project, prepared by the Office of Policy Analysis at New Mexico State University, estimated statewide project-related GRT of between $5.2 million and $6.2 million, over the life of the project (Peach et al. 2011).
- Personal and corporate income taxes: Construction and operation of the Proposed Action would generate estimated incremental personal and corporate income taxes of as much as $3.6 million over the life of the project (Peach et al. 2011).
- Federal payments in lieu of taxes: Implementation of the Proposed Action would have no or little affect on federal PILT, as it would not affect the acreage of federally managed land in the area; such acreage being a primarily determination of annual PILT.

Public service demands associated with the short-term and long-term population growth, jobs, housing, and other factors related to the Proposed Action would result in incremental pressures on public sector expenditures. Although not quantified in this assessment, the scale of the incremental short- and long-term demands associated with the proposed HB In-Situ Solution Mine Project would be limited. Consequently, from a fiscal perspective, implementation of the Proposed Action is likely to be beneficial, both in the short term and over the long term.

4.15.5.5 Social Organization and Conditions

Eddy County and its communities are familiar with natural resource development including potash mining, oil and gas development, construction projects and temporary work forces associated with such development. Consequently, construction of the project and the presence of the moderately sized construction work force are unlikely to result in social disruption in nearby communities. Given the letters submitted in support of the project by area economic development organizations and the City of Carlsbad during scoping and the fact that the Eddy County Commission approved industrial revenue bonds for the project, it is reasonable to assume that the project has broad local support. For many residents, the Proposed Action-related economic activity would likely be welcomed in wake of the recent economic malaise.

However, certain individuals and groups who have the potential to be adversely affected by the Proposed Action may be dissatisfied with the issuance of a ROW. These would include the few affected grazing operators, current recreation users of the area, and oil and gas operators with existing wells or development interests in the project area.

Affected grazing operators could be dissatisfied with the long-term reduction in AUMs related to disturbance, the need for more active livestock management, and potential for damage to grazing improvements, long-term reductions in forage and effects on water resources associated with groundwater pumping, increase in noxious and invasive weed species, and additional vehicle/livestock collisions associated with Proposed Action-related traffic (see Section 4.7, Rangelands and Livestock Grazing). Note that only one grazing allotment would lose more than 1 percent of totally permitted AUMs under the Proposed Action, and that allotment would lose about 4 percent. The mitigation measure suggested in Section 4.7, coupled with the applicant-committed environmental protection measures described in Section 2.4.5 and the range related BLM environmental requirements included in **Table 2-9** could help avoid or reduce some grazing operator dissatisfaction.

Hunters who currently use the project area and adjacent areas would likely be dissatisfied with the reduction in game associated with the Proposed Action and with the change in the recreational setting. Some hunter displacement may occur during project construction and to a lesser extent during project operations. OHV users who frequent the area, including the Hackberry Lake SRMA, may be dissatisfied with the industrial activity's traffic and overall impact on recreation setting, and safety concerns associated with subsidence and aboveground pipelines crossing RV trails. These effects would occur in a limited portion of the SRMA and, except for potential subsidence effects and aboveground pipelines, would be more prevalent during project construction.

The applicant-committed environmental protection measures described in Section 2.4.5 and the range related BLM environmental requirements included in **Table 2-9** could help reduce some dissatisfaction among recreation users of the project area.

Oil and gas operators with interests in the project area may be dissatisfied with the issuance of a ROW for the Proposed Action because it would generate concern about the effects of solution mining on abandoned and operating wells within the project area.

Collapses of cavern domes and the appearance of sinkholes in the Carlsbad area in recent years have given rise to increased local awareness and concern for subsidence associated with the operation of brine wells in the area. A number of scoping comments expressed concern for potential subsidence resulting from the Proposed Action and this concern may be heightened by issuance of a ROW for the Proposed Action. These concerns may be reduced by the implementation of the Applicant-committed subsidence monitoring plan described in Section 2.4.5 of this EIS.

4.15.5.6 Environmental Justice

Implementation of the Proposed Action would not be anticipated to result in significant adverse impacts to human health and environmental resources, nor would it have disproportionately high effects on minority or low-income populations in the region. Consequently, environmental justice concerns would not arise in conjunction with the Proposed Action.

4.15.6 Alternative B

Implementation of Alternative B, when compared to the Proposed Action, would require a slightly larger construction work force and additional capital investment to upgrade and install new water transmission pipelines to provide supplemental water from the Caprock Formation. The water pipeline work would be accomplished by a work force of approximately 13 workers over a 13- to 15-month period; with the additional work occurring concurrently with other construction activities, leaving the overall 14- to 18-month construction schedule unaffected. Projected long-term operations of the HB In-Situ Solution Mine Project under Alternative B would be the same as with the Proposed Action, encompassing 28 years of filling, solution withdrawal, evaporation and mineral precipitation, and final product processing and sales. Intrepid's incremental operational work force needs are estimated at 36 employees, the same as under the Proposed Action. Final reclamation activities would follow the conclusion of processing.

4.15.6.1 Economic Effects

Alternative B would result in slightly higher short-term employment and income effects than would occur with the Proposed Action, the differences due to the larger number of construction workers directly employed during the first through fifth quarters of construction (**Figure 4.15-3**). Intrepid's capital investment also would be higher than for the Proposed Action.

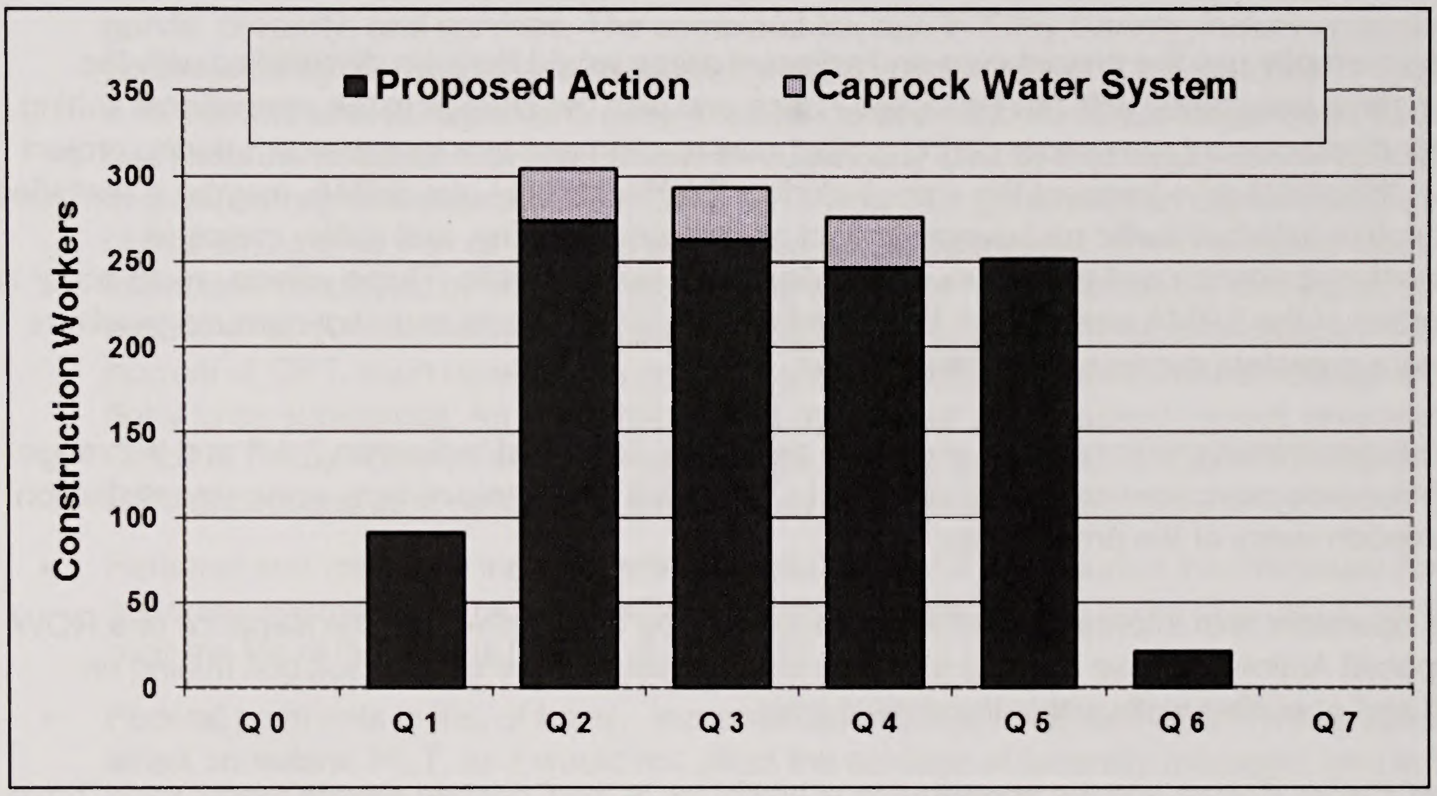

Figure 4.15-3 HB In-Situ Project Estimated Direct Construction Jobs—Alternative B

The short-term employment of 13 additional construction workers would support 10 additional indirect and induced jobs in the region, yielding an estimated average impact of 473, 23 higher than under the Proposed Action. The majority of the indirect and induced jobs would be based in Eddy County, although Lea County could realize incremental benefits associated with project-related spending by the temporary work force.

Alternative B would directly and indirectly generate an estimated $40.6 million in personal income during the 14- to 18-month construction period, approximately $2.1 million more than with the Proposed Action. The gains in personal income would represent short-term, benefits in the region. Motels, restaurants and cafes and other businesses catering to tourists and other visitors would realize increases in sales under Alternative B, the net magnitude of which would be slightly higher than under the Proposed Action.

The temporary jobs in construction and other industries supported by that activity would result in short-term, minor improvement in labor markets. Unemployment could decrease slightly for a short period.

The long-term direct, indirect, and induced economic effects associated with production under Alternative B would be comparable to those under the Proposed Action.

Implementation of Alternative B would have very limited adverse effects on grazing, recreation, and hunting, reducing the economic contributions associated with the activities. The magnitude of these effects would be comparable to those under the Proposed Action.

Oil and gas development within the project area would continue in accordance with the restrictions and requirements of the Secretary's Potash Order (*Federal Register* 1986) and OCC Order R-111-P.

Groundwater modeling completed for this assessment indicates a potential for groundwater drawdown in the portion of the Ogallala aquifer that supplies municipal water for the town of Lovington in Lea County. The extent, magnitude, timing, and potential economic implications of drawdowns on the community are uncertain, and that uncertainty represents a risk of potentially significant adverse economic effects not present under the Proposed Action. Also uncertain is the persistence of the drawdown and related effects after pumping ceases, although it is conceivable that the effects would extend beyond the life of project.

4.15.6.2 Population

Short-term population increases in Eddy County would be slightly higher under Alternative B, as compared to the Proposed Action, due to the higher number of construction workers employed directly on the project and an incremental increase in indirect and induced employment. Under Alternative B, the temporary influx of workers to fill the available jobs would result in an estimated pea k short-term population increase of 233 individuals, 12 higher than under the Proposed Action. Unaccompanied, single-status construction workers would account for much of the population increase, arriving in the area to work on the project, returning to their permanent residence when the project is completed.

Some of the in-migrating workers would be accompanied by spouses or partners, some of whom may be employed on the project as well or find other temporary jobs in the community.

Due to the temporary nature of the construction jobs under Alternative B, the number of families migrating into the area would be low. Consequently, few school age children would be among the migrating population.

The projected long-term population increment associated with implementation of Alternative B is 29, 4 to 6 of whom would be school-age children, the same as under the Proposed Action. Based on the 28 year production life of the project, some of the adult residents among this population would likely remain in the region after the conclusion of production associated with Alternative B.

4.15.6.3 Housing

Implementation of Alternative B would result in temporary demands on motels, hotels, RV parks, apartments, and rental housing in the area. Total peak needs are estimated at 147 units, 7 more than under the Proposed Action. The additional need would result in more pressure on the available supply in Carlsbad, marginally increasing the potential that some workers would find it necessary to secure temporary housing in other nearby communities and endure longer daily commutes. The short-term demands associated with Alternative B are reasonably comparable to those under the Proposed Action but would create additional competition with seasonal demands associated with tourism and recreation.

Long-term housing demand for 10 units of conventional single and multi-family housing associated with Alternative B would be the same as under the Proposed Action. That level of demand can be met from within the existing housing supply, augmented by the capacity of the residential construction industry to develop new housing.

4.15.6.4 Public Infrastructure, Services, and Local Government Fiscal Conditions

As with the Proposed Action, Alternative B-related effects on local government infrastructure and services are likely to be minimal given the relatively small estimated short and long-term population influxes. Construction workers associated with Alternative B are assumed to be housed in existing temporary and conventional housing units, which are currently served by utilities and should be accommodated with existing capacity. Demands associated with operations workers under Alternative B would be the same as the Proposed Action.

The traffic and industrial activity associated with Alternative B construction activities would be slightly greater and distributed over a somewhat broader area than that associated with the Proposed Action, resulting in the potential for additional demand for Eddy County law enforcement, emergency response and emergency medical services as compared to the Proposed Action, but the incremental demand would be anticipated to be relatively minor and similar in nature to existing demand.

Short and long-term fiscal effects associated with implementation of Alternative B would be largely comparable to those under the Proposed Action. In the short-term, GRT and personal and corporate income taxes would be slightly higher due to the increases in capital investment, higher labor income, and additional taxable purchases of goods and services by construction workers associated with the project. Public expenditures that are sensitive to seasonal and other short-term demand, for instance, some local law enforcement services, may be higher under Alternative B than under the Proposed Action. Many public facilities and services, however, would either be unaffected or unable to distinguish the demands from other seasonal influences or year-to-year variations in demand. The net fiscal effects would be minor due to the temporary nature and limited scale of the demand and revenue flows.

Because Alternative B leaves projected production and life of the project unaffected, long-term tax revenues such as federal mineral royalties that are tied to production levels and value of output under Alternative B would be comparable to those under the Proposed Action. Alternative B would yield slightly higher local ad valorem/property taxes due to the higher capital investment associated with the development of an alternative water source. Those differences would extend over the operational life of the project.

4.15.6.5 Social Organization and Conditions

Effects of Alternative B on social organization and conditions within the project area would be similar to those associated with the Proposed Action, with the exception that the forecast groundwater drawdown over a larger area is likely to raise concerns among additional individuals, groups, and organization about the potential environmental effects of such drawdown.

4.15.6.6 Environmental Justice

Implementation of Alternative B would not be anticipated to result in any disproportionately high adverse human health and environmental effects on minority or low-income populations in the region. Consequently, environmental justice concerns would not arise in conjunction with Alternative B.

4.15.7 Alternative C

Implementation of Alternative C would employ a slightly larger construction work force over a period of several months to bury existing and newly built water transmission pipelines that would be used to fill and withdraw water from the mine workings. Burial of the pipelines would occur with the same time frame as the other project development activities, leaving the overall 14- to 18-month construction schedule unaffected. Long-term operations of the HB In-Situ Solution Mine Project would encompass 28 years of filling, solution withdrawal, evaporation and mineral precipitation, and final product processing and sales. Intrepid's incremental operational work force needs are estimated at 36 employees, the same as under the Proposed Action. Final reclamation activities would follow the conclusion of processing.

4.15.7.1 Economic Effects

Alternative C would result in slightly higher temporary employment and income effects than would occur with the Proposed Action, the differences due to the slightly larger number of construction workers directly employed during the second and third quarters of construction. Intrepid's total capital investment also would be slightly higher than for the Proposed Action.

The short-term employment of additional construction workers would support a few additional indirect and induced jobs in the region. The majority of the indirect and induced jobs would be based in Eddy County.

Alternative C would directly and indirectly generate slightly higher personal income during the 14- to 18-month construction period, than would result from the Proposed Action. The gains in personal income would represent short-term, benefits in the region. Motels, restaurants and cafes and other businesses catering to tourists and other visitors would realize increases in sales under Alternative C, the net magnitude of which would be slightly above those under the Proposed Action.

The temporary jobs in construction and other industries supported by that activity would result in short-term, minor improvement in labor markets. Unemployment would decrease slightly for a short period.

The long-term direct, indirect, and induced economic effects associated with production under Alternative C would be the same as those under the Proposed Action.

Oil and gas development within the project area would continue in accordance with the restrictions and requirements of the Secretary's Potash Order (*Federal Register* 1986) and OCC Order R-111-P.

Implementation of Alternative C would have fewer adverse effects on grazing and OHV riding as compared to the Proposed Action because the buried pipelines would remove obstacles for livestock movement and obstacles and safety concerns for OHV riders, consequently the economic effects of Alternative C on these activities would likely be somewhat less adverse as compared to those associated with the Proposed Action. Economic effects of Alternative C on hunting would be comparable to those under the Proposed Action.

4.15.7.2 Population and Demographics

The short-term population increases in Eddy County would be slightly higher under Alternative C, as compared to the Proposed Action, but lower than under Alternative B.

The projected long-term population increment associated with implementation of Alternative C is 29, 4 to 6 of whom would be school-age children, the same as under the Proposed Action. Based on the 28-year production life of the Project, some of the adult residents among this population would likely remain in the region after the conclusion of production associated with Alternative C.

4.15.7.3 Housing

Implementation of Alternative C would result in temporary demand on motels, hotels, RV parks, apartments, and rental housing in the area. The average demand on temporary housing under Alternative C would be slightly higher than with the Proposed Action, but peak demand would be the same because the incremental need would occur in the second and third quarters of construction, prior to the peak. The incremental need would marginally increase the potential of some workers finding it necessary to secure temporary housing in other nearby communities. The short-term demands associated with Alternative C could compete with seasonal demands associated with tourism and recreation, in the same manner as would the Proposed Action.

Long-term housing demand under Alternative C would be the same as under the Proposed Action. That level of demand can be met from within the existing housing supply, augmented by the capacity of the residential construction industry to develop new housing.

4.15.7.4 Public Infrastructure, Services, and Local Government Fiscal Conditions

As with the Proposed Action, Alternative C-related effects on local government infrastructure and services are likely to be minimal, given the estimated short and long-term population influxes.

Construction workers associated with Alternative C are assumed to be housed in existing temporary and conventional housing units, which are currently served by utilities and should be accommodated with existing capacity. Demands associated with operations workers under Alternative C would be the same as the Proposed Action.

The traffic and industrial activity associated with Alternative C construction activities would be slightly greater but occur within the same area as that associated with the Proposed Action, resulting in comparable additional demands on Eddy County law enforcement, emergency response, and emergency medical services as the Proposed Action. The incremental demand would be anticipated to be relatively minor and similar in nature to existing demand.

Short and long-term fiscal effects associated with implementation of Alternative C would be essentially the same as those under the Proposed Action. In the short-term, GRT and personal and corporate income taxes would be slightly higher due to the increases in taxable purchases of goods and services by construction workers associated with the project. Most public facilities and services would either be unaffected or unable to distinguish the demands from other seasonal influences or year-to-year variations in demand. The net fiscal effects would be very limited due to the temporary nature and scale of the demand and revenue flows.

Alternative C leaves projected production and life of the project unaffected. The capital investment also would be largely unaffected. As a result long-term tax revenues over the life of the project would be the same under Alternative C as under the Proposed Action.

4.15.7.5 Social Organization and Conditions

Effects of Alternative C on social organization and conditions within the project area would be similar to those associated with the Proposed Action, with the exception that concerns of grazing operators and OHV users about the effects of aboveground pipelines on their activities would be eliminated.

4.15.7.6 Environmental Justice

Implementation of Alternative C would not be anticipated to result in any disproportionately high adverse human health and environmental effects on minority or low-income populations in the region. Consequently, environmental justice concerns would not arise in conjunction with Alternative C.

4.15.8 Alternative D—Preferred Alternative

Implementation of the Preferred Alternative would occur over a 20- to 24-month timetable, 6- to 9-months longer than the Proposed Action. Intrepid estimates additional investment of $190 million to $200 million to implement the Preferred Alternative. Relocation of existing power, natural gas, and fiber optic lines, development of evaporation ponds, construction of a new mill, and work to put additional water pumps, transmission lines and other support facilities in place will support short-term construction related jobs in the local economy, both directly and indirectly. Project timetable and direct employment estimates provided by Intrepid call for initial construction activity in the first quarter of 2012, employing up to 74 construction workers.[2]

Thereafter direct employment would increase to a peak of 272 jobs in the first quarter of 2013, primarily in conjunction with construction of the new mill and evaporation ponds. Construction employment would remain at approximately 175 workers through the third quarter of 2013 until construction is substantially completed, declining to about 20 jobs to finalize completion of the evaporation ponds (**Figure 4.15-4**) (Intrepid Potash Inc. 2011).[3]

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[2] Assuming a Record of Decision and permit to proceed by mid-first quarter 2012.

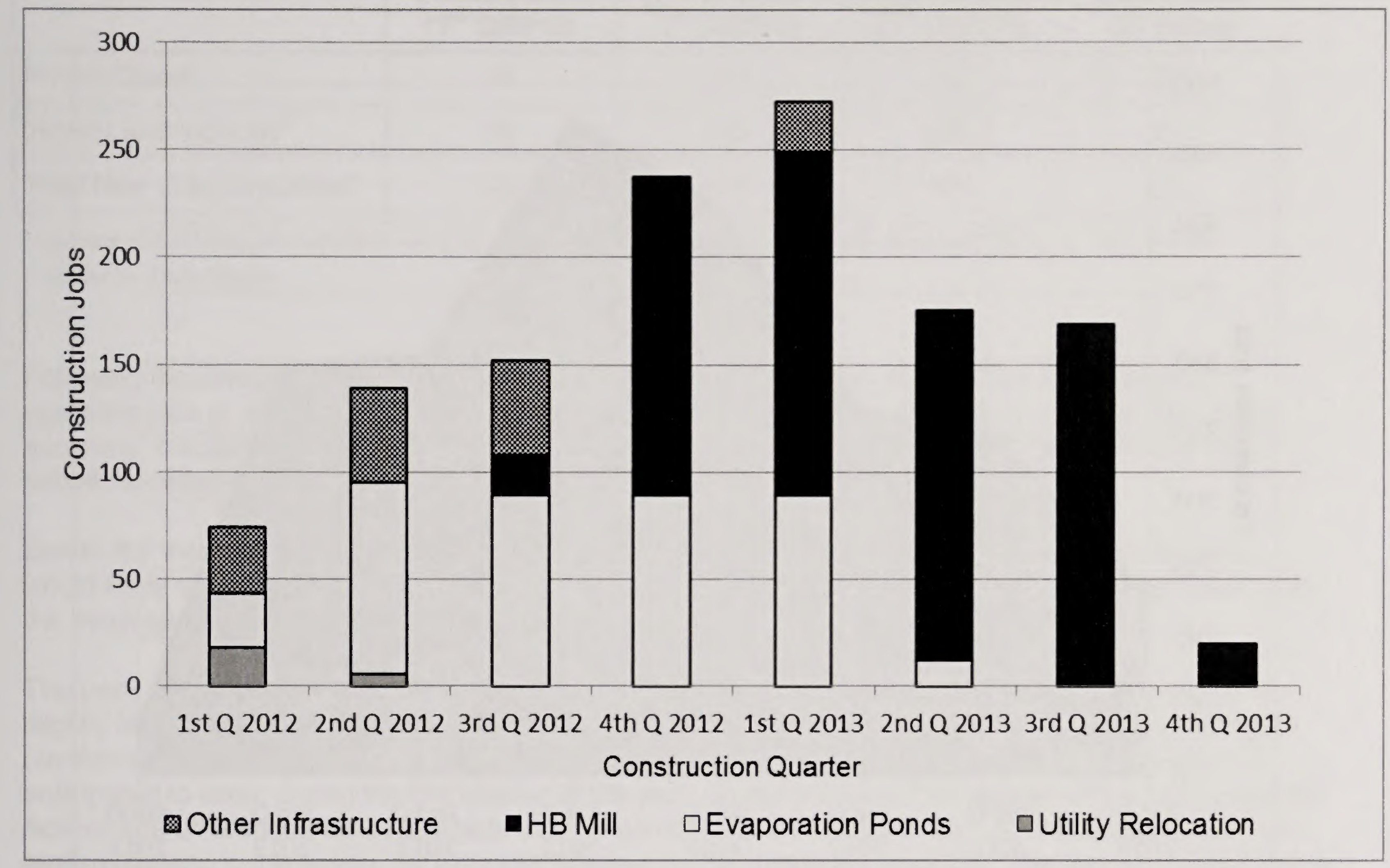

Figure 4.15-4 HB In-Situ Project Estimated Direct Construction Jobs for the Preferred Alternative

Ongoing production costs for the in-situ project are estimated at $11.4 million to $13.9 million during a typical year. Long-term operations of the HB In-Situ Solution Mine Project would encompass 28 years of filling, solution withdrawal, evaporation and mineral precipitation, and final product processing and sales. Intrepid's incremental operational work force needs are estimated at 36 employees, the same as under the other action alternatives.

4.15.8.1 Economic Effects

The Preferred Alternative would require a higher level of temporary construction labor to complete, as compared to the Proposed Action, thereby supporting more temporary indirect and induced employment in the region. The increase would result primarily from the longer period of construction, rather than an increase in the peak or average number of jobs indirectly supported.

The overall short-term stimulus associated with the Preferred Alternative would be 130 jobs during the initial quarter of construction activity; averaging 334 jobs over the subsequent 18 months of construction activity, and with a short term peak of up to 476 jobs in the first quarter of 2013 (see **Figure 4.15-5** and **Table 4.15-4**). The majority of these jobs would be based in Eddy County, although Lea County would likely realize benefits from the jobs based on economic linkages to Eddy County and the fact that some temporary residents may seek temporary housing in Hobbs or elsewhere in Lea County.

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[3] Further perspectives on the potential economic impacts associated with the proposed project can be found in "The Economic Impacts of Intrepid Potash, Inc.'s Proposed HB Solar Solution Mine Project in Eddy County, New Mexico", 2011. The report was prepared by J. Peach, et al, at the Arrowhead Center, New Mexico State University under contract to Intrepid Potash, Inc.

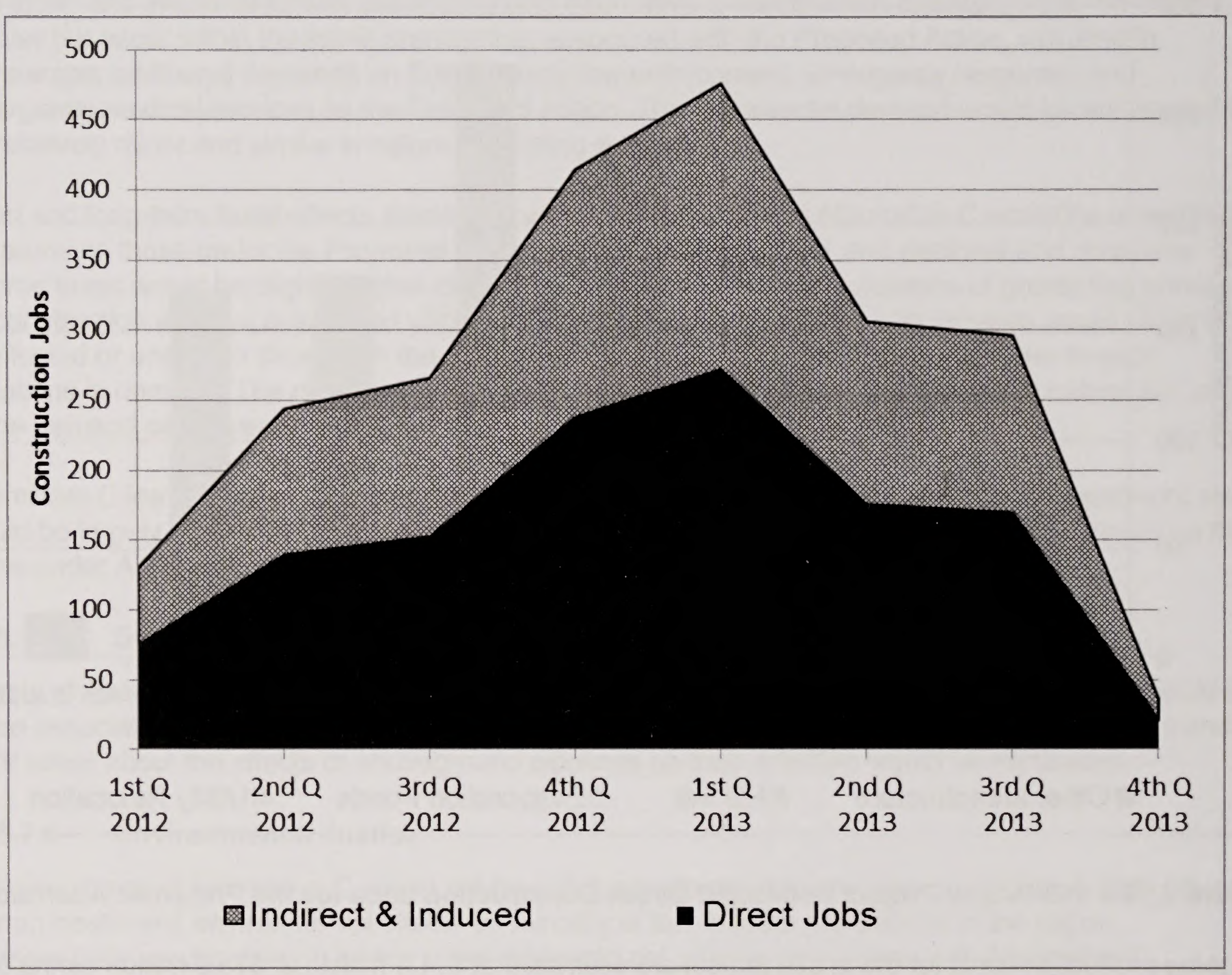


Figure 4.15-5 Total Temporary Employment Effects Associated With the Preferred Alternative

Table 4.15-4 Total Employment Effects of the Preferred Alternative

	Initial Construction (1st Q/2012)	Average (2nd Q/ 2012 - 3rd Q/2013)	Peak Quarter (1st Q/2013)	Long-term Operations (28 years)
Project Direct	74	191	272	36
Indirect and Induced [1]	56	143	204	19
Total New Jobs Supported	130	334	476	55

[1] Indirect and induced job multipliers are 0.75 per direct construction job and 0.54 per direct operations job, per IMPLAN model for Eddy County.

Following the completion of construction and transition to operations, the addition of 36 long-term operating jobs at Intrepid under the Preferred Alternative would indirectly support 19 other jobs in the economy, the same number as under the Proposed Action. The net result would be a net long-term beneficial effect of 55 jobs.

Due to the increased area and facilities to be reclaimed, implementation of the Preferred Alternative would likely support a slightly higher level of employment during final reclamation than would result from the Proposed Action.

The peak number of temporary workers migrating to fill jobs under the Preferred Alternative would be slightly higher than under the Proposed Action, 160 compared to 152 workers, however, the average number of jobs over the entire construction period would be lower. Furthermore, the peak quarter is anticipated to occur during the first quarter of the year, as compared to third quarter under the Proposed Action. The difference means less potential competition/conflict between the with the traditional primary tourism season in the region, for example, competition for temporary housing, The resident labor force is expected to allow current residents of the area to fill most of the long-term jobs, resulting in just 12 additional workers in the local labor force (see **Table 4.15-5**).

Table 4.15-5 Residency Status of Workers Filling Temporary Jobs Associated with the Preferred Alternative

	Initial Construction (1st Q/2012)	Average (2nd Q/2012 - 3rd Q/2013)	Peak Quarter (1st Q/2013)	Long-term Operations (28 years)
Total New Jobs Supported	130	334	476	55
Jobs Filled by Residents and Commuters (conservative)[1]	86	222	316	43
Jobs Filled by In-migrating Workers	44	112	160	12

[1] Local residents and commuters are assumed to fill between 60 and 80 percent of the direct, indirect, and induced jobs supported by the proposed project.

The Preferred Alternative would result in beneficial short-term and long-term increases in personal income in the region. The short-term increases, estimated at $47.5 to $50.0 million, would be higher than under the Proposed Action. Although much of the income accruing to non-residents would leave the region, the local economy would benefit from local purchases of goods and services made by non-local workers during their time of local tenancy.

The long-term increase in personal income extending over the 28-year life of the project would be the same as under the Proposed Action.

Project-related effects on grazing and outdoor recreation would be comparable to those under the Proposed Action. The gains in income associated with the Preferred Alternative would greatly offset these declines on a net basis. Jobs in the construction and mining industries are among the highest paying jobs in the local economy, thereby contributing to enhanced economic welfare for the directly affected households.

As would be true under the Proposed Action, future oil and gas development within the project area under the Preferred Action would continue in accordance with the restrictions and requirements of the Secretary's Potash Order (*Federal Register* 1986) and OCC Order R-111-P.

4.15.8.2 Population and Demographics

The temporary population influx into Eddy County is estimated at up to 58 individuals during the initial quarter of construction, averaging 153 individuals during the subsequent 18 months, with a short term peak of 221 persons. Thereafter, the population gain would decline to 24 as construction is completed and the project transitions to long-term operation (**Table 4.15-6**). Some of the temporary workers may secure long-term jobs allowing them to remain in the region, but most would return to their permanent residence, or move on to another project when the project is completed.

Table 4.15-6 Short-Term Demographic Effects Associated with the Preferred Alternative

	Initial Construction (1st Q/2012)	Average (2nd Q/2012 - 3rd Q/2013)	Peak Quarter (1st Q/2013)	Long-term Operations (28 years)
Jobs Filled by In-migrating Workers	44	112	160	12
Short-term Population Influx	58	153	221	24
School-age children	<5	5 to 8	8 to 10	4 to 6

The number of school-age children entering local schools as a result of the Preferred Alternative is estimated at 10 or fewer during construction, comparable to the potential enrollment increase as under the Proposed Action. Some of those students could be mid-year transfers and remain for a year or less. The projected long-term population increment associated with the Preferred Action would be 4 to 6 school-age children, the same as for the Proposed Action.

4.15.8.3 Housing

Based on the above employment and population assessments above, the Preferred Alternative would create demand for up to 140 housing units in the first quarter of 2013. Most of that demand would be associated with non-local single-status construction workers and likely be accommodated in hotels, motels and RV parks in and near Carlsbad. The remaining incremental demand would be associated with workers such as construction management personnel who relocated with other household members, construction workers who expect to be on site throughout much of the overall construction period, or workers who relocate to the area to accept indirect or induced jobs supported by the project and thus would be more likely to seek conventional housing such as rental homes or apartments.

Long-term housing demand under the Preferred Alternative would be the same as under the Proposed Action. That level of demand could be met from within the existing housing supply, augmented by the capacity of the residential construction industry to develop new housing.

4.15.8.4 Public Infrastructure, Services, and Local Government Fiscal Conditions

Foreseeable effects on local government infrastructure and services under the Preferred Alternative are likely to be minimal given the estimated short- and long-term population influxes to the region. Most public facilities and services would either be unaffected or unable to distinguish the demands from other seasonal influences or year-to-year variations in demand.

The net fiscal effects are expected to be beneficial and long-term due to the temporary nature and limited scale of the incremental demand as compared to the long-term flows of revenues to the state and local governments.

4.15.8.5 Social Organization and Conditions

Effects of Preferred Alternative on social organization and conditions within the project area would be similar to those associated with the Proposed Action, other than that some concerns of grazing operators and OHV users about the effects of aboveground pipelines on their activities would be reduced.

4.15.8.6 Environmental Justice

Environmental justice concerns would not arise in conjunction with the Preferred Alternative.

4.15.9 Summary of Impacts

The continuation of current economic drivers would be anticipated to sustain the region's economy for the foreseeable future, providing a relative high degree of economic vitality and diversity for its residents and a fiscal foundation for local government. Population projections anticipate moderate long-term growth for Eddy County, with net growth of nearly 7,500 residents projected between 2010 and 2035 (UNM-BBER 2008).

Under the Preferred Alternative short term direct employment would increase by an average of 177 jobs in conjunction with construction activities, with a temporary peak of 272 jobs. The temporary jobs in construction and other industries supported by that activity would result in short-term, minor improvement in labor markets. Unemployment would decrease slightly for a short period.

Intrepid's existing operational work force of 629 employees would be expanded by 36 positions for the operational phase of the proposed project. The majority of these jobs would be based in Eddy County. Under the Proposed Action, the increase in operational employment at Intrepid would support an estimated 19 indirect and induced jobs elsewhere in the economy, for a net long-term beneficial effect of 55 jobs. The Preferred Alternative would result in net beneficial short-term and long-term increases in personal income in the region.

A short-term population influx would occur in conjunction with work force migration to fill temporary direct, indirect, and induced job opportunities. Short-term population increases in Eddy County from the Preferred Alternative are estimated at up to 221 individuals. The temporary population gains would create demand on motels, hotels, RV parks, apartments, and rental housing in the area. Total peak demand is estimated at 140 units. Foreseeable effects on local government infrastructure, services, and expenditures are likely to be minimal under the Preferred Alternative.

Implementation of the Preferred Alternative would result in substantial increases in Federal Mineral Royalties, and local ad valorem/property, gross receipts, and personal and corporate income taxes over the life of the project.

Implementation of the Preferred Alternative would not be anticipated to result in significant adverse impacts to human health and environmental resources, and would not have disproportionately high effects on minority or low-income populations in the region. Consequently, environmental justice concerns would not arise.

4.16 Summary of Irreversible and Irretrievable Commitments of Resources

Selection and approval of any of the action alternatives could result in the irreversible commitment of specific resources (e.g., the loss of future options for resource development or management), especially for nonrenewable resources such as minerals or cultural resources. It also would result in the irretrievable commitment of resources, defined as the lost production or use of renewable natural resources during the life of the operations. The irreversible commitment of irretrievable resources for this project is anticipated to be minimal. Those resources that would be affected by irreversible or irretrievable commitments are summarized below.

Geology and Minerals. Approximately 185,000 tons of salable potash is estimated to be produced each year that the evaporation ponds yield marketable precipitate (approximately 26 years). This would result in both irreversible and irretrievable commitments of potash ore.

Groundwater. Groundwater levels affected by proposed pumping operations are predicted to partially recover in the Rustler Formation in the long term. Groundwater recharge would be very slow and unpredictable, but not entirely irreversible. Groundwater levels drawn from the Caprock Aquifer would recover much more quickly, so there would not be an irreversible commitment of that resource. The water lost from the evaporation ponds would result in an irretrievable commitment of groundwater.

Soils. The soils that are excavated to construct project facilities, especially to install pipelines and construct the new HB mill, would be permanently altered because the soil horizons would be mixed. Even after reclamation, soil productivity may return but the excavations would result in irreversible alterations of the natural soils.

Socioeconomics. The economic investment and human effort by employable labor associated with the construction and operation of the proposed project could be considered an irreversible commitment of resources. However, this commitment could be viewed as a positive impact due to the jobs created or maintained in this area that relies on mineral development as a major employer.

Energy. Construction and operation of the proposed project would require the commitment of an irretrievable volume of fuel, diesel fuel and gasoline, as well as fuel to generate electricity for the mill and other required operations.

5.0 Cumulative Impacts

5.1 Overview

In its Regulations for Implementing NEPA (40 CFR Parts 1500-1508), the CEQ defines a cumulative impact as follows in Section 1508.7:

> *"Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative impacts are the combination of the individual effects of multiple actions over time in the context of other development in the project area or the region. The individual effects may be minor when considered separately but may be major or significant when considered in combination with all others in the region. A CEQ memorandum issued in 2005 (CEQ 2005) provides additional guidance on the consideration of past actions in cumulative effects analysis. This memorandum stresses the "forward-looking" nature of NEPA analysis. It states that the effects of past actions are only required to be analyzed if they are relevant and useful to determine whether the proposed project "may have a continuing, additive and significant relationship" to projected future impacts in the region.

The relevant past and current actions within the project area contributed to the current conditions described as the affected environment in Chapter 3.0. For this reason, the cumulative impact analysis included in this chapter focuses primarily on reasonably foreseeable future actions that are known by the BLM at the time the analysis was performed. The impacts of the proposed project and the reasonably foreseeable future actions, along with the effects of the past and current activities that affect the same resources, would combine to have a cumulative impact on the environment in the region.

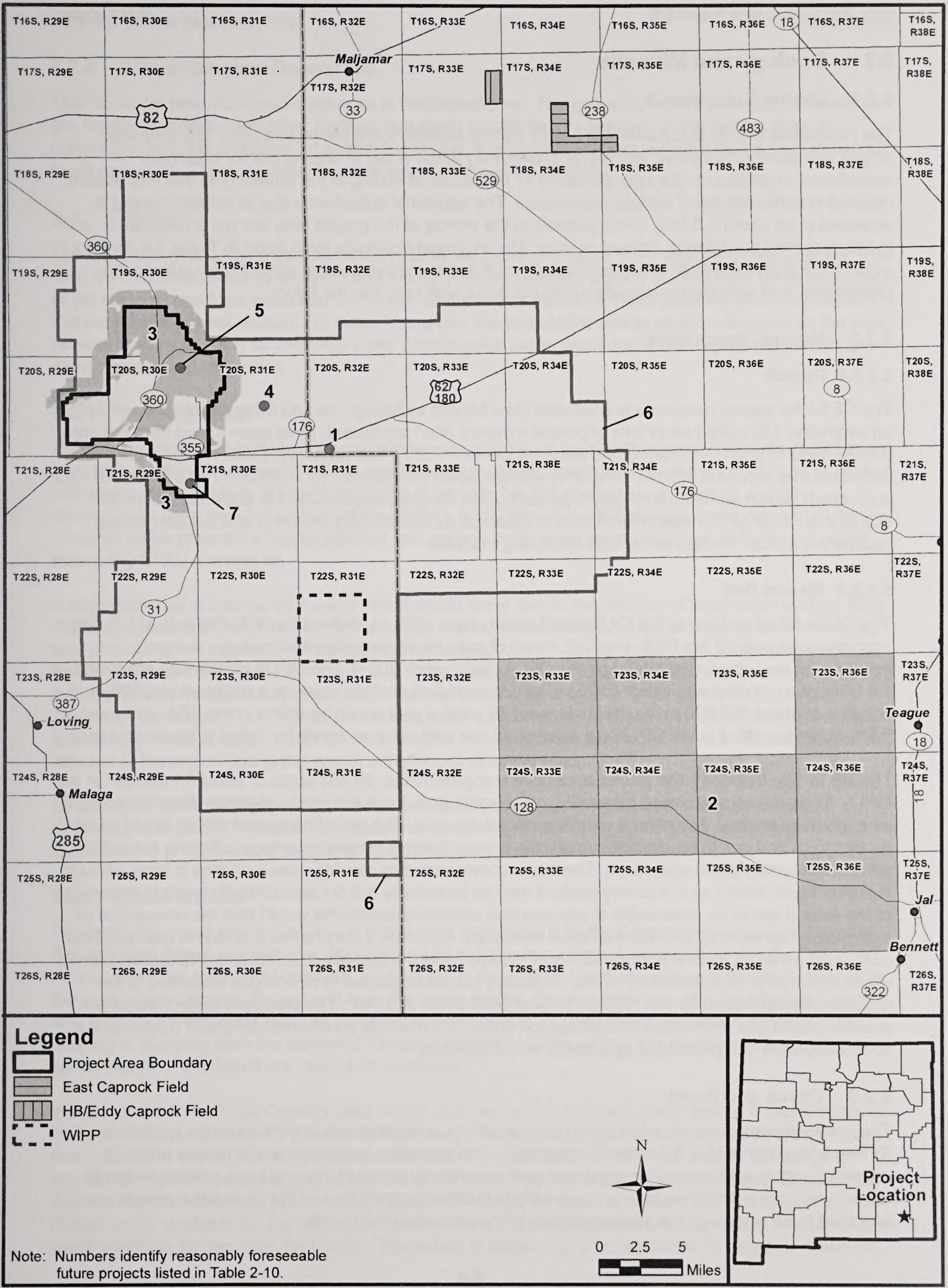
Almost 13 percent (4,822 acres) of the project area is affected by surface disturbance due to the previous installation of facilities such as roads, pipelines, well pads, OHV trails, tailings piles and ponds, and mine plants. This disturbance occurred in the past and is currently being maintained to support mineral development, mining operations, recreational activities, or other approved land uses.

The areas that are covered with impervious materials (concrete, hardened salt, roofs, for example) would not contribute to accelerated soil erosion or fugitive dust emissions but would contribute to increased surface water runoff and loss of forage for livestock and wildlife. Other past and present activities include vegetation treatments to manage invasive plants and improve forage, such as those that are part of the Restore New Mexico program.

The activities and proposed projects listed in **Table 5-1** are reasonably foreseeable in the vicinity of the SPA. The approximate location of each project is displayed on **Figure 5-1**. The list includes actions that are likely to affect the same resources that were analyzed in Chapter 4.0. The areas of potential impacts may vary from one resource to another, and are described for each resource in the following sections. The impacts of these activities on the region over the life of the proposed project (28 years) were considered in combination with the proposed HB In-Situ Solution Mine Project and other past and ongoing activities to predict the potential cumulative effects of all actions combined on each of the resources analyzed in the EIS.

Table 5-1 Reasonably Foreseeable Future Actions in the Region

Project	Brief Description	Approximate Location
1. Intrepid water-saving improvements	Planned upgrades to Intrepid's East Mine langbeinite process plant, projected to be completed by the end of 2011, anticipated to decrease Caprock water usage by approximately 700 to 800 gpm.	Intrepid East Mill
2. Polyhalite mining project	Intercontinental Potash is proposing a polyhalite mining operation on state and federal mineral leases and surface. The planned extraction method is underground room and pillar mining approximately 1,500 feet below the surface. Exploratory drilling is ongoing to evaluate the extent and quality of the potash formations. Water for processing is proposed to come from the Capitan Aquifer.	In five townships in Lea County, New Mexico, approximately 9 miles from the eastern boundary of the SPA
3. BLM vegetation management	As part of the Restore New Mexico program, the BLM plans several chemical treatments to manage invasive plants (mesquite and creosote). No surface disturbance is planned.	Within and near project area
4. Construction and maintenance for recreation	There is a proposal to construct a new parking lot in the Hackberry Recreation Area, approximately 0.5 to 1 acre in size. Trail maintenance is ongoing and involves little, if any, surface disturbance.	Hackberry Recreation Area
5. Creamer water project	A private landowner is proposing to develop a well on state land to supply saline water for sale to the oil and gas industry. The water may be coming from the Rustler Formation. Also proposing a pipeline running north up a small dirt road, crossing under the highway and ending at an old caliche pit where storage tanks would be installed.	Section 2, T20S, R30E (southeast of Clayton Lake)
6. Oil and gas drilling and production	Oil and gas drilling of new wells and production from existing wells would continue in the SPA according to BLM policy and approval. It is anticipated that oil and gas drilling operations would continue at the current rate of 75 per year in the SPA and an average of 1 per year within the project area. An average of 3.5 acres would be disturbed for each new well pad constructed.	In the SPA and project area
7. Derrick well	Intrepid recently converted an old core hole to a water supply well in the vicinity of the Rustler wells proposed for the project. The well extracts from the Rustler Formation, using the same source as the proposed new Rustler wells. Intrepid anticipates using this well at a rate of approximately 20 gpm to supplement processing water at the West Plant.	Section 1, T21S, R29E



Note: Numbers identify reasonably foreseeable future projects listed in Table 2-10.

Figure 5-1 Locations of Reasonably Foreseeable Future Actions

5.2 Geology and Minerals

5.2.1 Mining Subsidence

The cumulative effects study area (CESA) for mining subsidence is the project area. The proposed project and alternatives would result in approximately 4,354 acres of area at risk for additional subsidence, in addition to the approximately 17,000 acres of mining in the project area that has already resulted in some degree of surface subsidence. The additional subsidence due to solution mining is expected to be about 0.6 foot. Other projects in the vicinity of the project area are not anticipated to add to this projected subsidence amount or area. The proposed polyhalite mine listed in **Table 5-1**, Project 2, would most likely contribute to regional subsidence due to mining, but this project is far outside the project area and subsidence impacts would not occur until long into the future.

5.2.2 Mineral Resources

5.2.2.1 Potash

The CESA for potash resources is southeast New Mexico including Lea and Eddy counties. As of 2009, an estimated 138 million short tons of potash minerals (K_2O equivalent) have been mined from the area (USGS 1933 to 2004; NM Mining and Minerals Division 2009). The proposed solution mining project estimates that around 6,000,000 tons of sylvite ore would be removed (or roughly 3,780,000 tons of K_2O equivalent), which represents roughly 3 percent of the cumulative production to 2009. Based on the USGS's estimate of 551 million short tons of resource (USGS 2009a), the proposed solution mining recovery is a small fraction of the total remaining resource.

5.2.2.2 Oil and Gas

The CESA for oil and gas is the Oil Potash Leasing Area (OPLA), defined by OCC Order R-111-P that encompasses most of the SPA. The OPLA was chosen because a recent oil and gas resource assessment was conducted based on the OPLA (Balch et al. 2009). The OPLA contains an estimated 1.4 billion barrels of oil equivalent (BOE) of undiscovered oil and gas resources (Balch et al. 2009) and consists of about 362,000 acres. It is estimated 75 wells a year would be drilled in the SPA, and most of them would be drilled in the OPLA. An average of one well per year would be drilled in the project area.

The HB In-Situ Solution Mine project area covers approximately 38,453 acres or about 11 percent of the OPLA. The area encompassed by existing mine workings is large enough to preclude directional drilling as a recovery method except for a small fraction of the area. The use of horizontal drilling would enable access to oil and gas to be extracted under the potash-bearing formations without affecting the solution and conventional mining operations. The area encompassed by existing mine workings is large enough that directional drilling as a recovery method may be technically but not economically feasible in portions of the area. It would be reasonable to assume that economic constraints would limit the recovery of oil and gas resources in spite of technological advances. However, it may not be possible to estimate how much fluid minerals recovery would be lost or delayed until the end of potash mining. Production islands would continue to be established where necessary to enable access to oil and gas according to the procedures established by the 1986 Order and OCC Order R-111-P. The proposed project would not prevent oil and gas exploration and production in the OPLA where no commercial-grade potash occurs so development and production operations would continue.

5.2.3 Caves and Karst

The protection measures for caves and karsts applied to this proposed project would be applied to RFFAs where the BLM is the authorizing agency. The protection measures would reduce potential impacts to caves and cumulative impacts would accordingly be small. Natural karst processes would continue to pose risks for surface and subsurface facilities in the area and the cumulative effects are expected to be small with the implementation of the protection measures.

5.2.4 Paleontological Resources

The CESA for paleontological resources is the project area. The generally limited potential for fossils in the Rustler Formation and other bedrock that could be affected by activities in the project area, in conjunction with the proposed protection measures, would result in a low potential for adverse impacts to fossil resources. The cumulative impacts are expected to be negligible.

5.3 Water

The CESA for groundwater resources is the SPA, as shown in **Figure 3.3-1** along with the Caprock area near Intrepid's well fields in western Lea County. Past and present actions are reflected in the description of the current conditions described in affected environment Section 3.3 and have not been calculated for this cumulative impact section. For water resources, the cumulative effects analysis focused on the past, present, and reasonably foreseeable water conservation plans, additional water depletions, oil and gas development, and recreation.

5.3.1 Surface Water

Cumulative impacts to surface water resources primarily would be directly related to ground disturbance from construction for additional mining and oil and gas development because it may contribute to erosion and sedimentation. Up to approximately 260 acres may be disturbed annually from oil and gas development (less than 0.1 percent of the CESA). Additional minor disturbance would occur from the Creamer water project if a supply pipeline and storage tanks were constructed and from the proposed Hackberry SRMA parking lot.

A slight increase in total surface water runoff would occur due to the addition of impervious surface from the establishment of the new HB mill, well pads, roads, and other associated structures where the land was previously natural soil and vegetation. The construction of new structures and roads associated with Projects 4, 5, and 6 in **Table 5-1** would add to the total amount of impervious surface and associated increase in stormwater runoff. Because the terrain in the project area is flat to gently sloping with numerous depressions, the increased surface water runoff is likely to travel only short distances before infiltrating the soil, so there would be little increase in downstream flooding or flows in drainageways and streams in the region due to the combined effect of all construction.

Because the surface disturbance would be scattered throughout the SPA and would be stabilized according to BLM requirements, this additional surface disturbance, in combination with the proposed solution mine project, would have only a minor impact on surface water quality.

5.3.2 Groundwater

Groundwater drawdown in the Clayton Basin area associated with the Creamer Project would increase the projected drawdown from the proposed in-situ solution mine project, especially under the Proposed Action where the majority of pumping would occur in the Rustler North area, approximately 2 miles from the area of the Creamer Project and from the same aquifer. Groundwater also may be affected if new fluid mineral development requires pumping to supply water for drilling mud. However, the projected quantity of pumping from the proposed Creamer Project or future oil and gas development is unknown, so the extent of the drawdown cannot be predicted.

Water withdrawn from the Caprock area would decrease under Intrepid's water-saving improvements at its East Mine process plant (Project 1 in **Table 5-1**). The amount projected to be saved would be more than enough to offset Caprock pumping under the Proposed Action, and would lessen the pumping impacts discussed under the Alternative B and Preferred Alternative pumping scenarios in Chapter 4.0. Water withdrawn from the Derrick well (Project 7 in **Table 5-1**) would potentially limit the amount of Rustler water available for the HB In-Situ Solution Mine Project because there is a limited amount of water available for use from the Rustler. The extent of drawdown is not expected to increase, however, and the Enhanced Calibration Model drawdown results presented in Section 4.3 would cover all pumping in the Rustler South area. Under the Preferred Alternative, with the combination of Rustler and Caprock water proposed for the solution mine project, the flexibility in water sources would accommodate using Rustler water from the Derrick well without further affecting groundwater drawdown as analyzed in Chapter 4.0, so there would be no change in the impacts presented.

Water would be needed for the processing plant at the proposed Intercontinental Potash polyhalite mine operation. If the primary groundwater source is the Capitan Aquifer as proposed, it is unlikely that this project would combine with the HB In-Situ project groundwater drawdown to cause cumulative impacts to regional groundwater or increased reductions of groundwater contributions to the Pecos River.

5.4 Soil

The CESA for soils is the same as the project area boundary plus the ROW that would be disturbed for the Caprock pipelines. Reasonably foreseeable projects that would be expected to produce incremental and cumulative impacts within the analysis area are summarized in **Table 5-1**. These projects would contribute incremental changes to the current level of effects to soil resources described in the analysis area from historic and ongoing management activities.

Projects that have contributed to cumulative impacts to soils result from surface disturbance associated with mining, grazing, vegetation management, recreation, oil and gas exploration and development, roads, and other natural and anthropogenic activities within the analysis area. Impacts associated with these types of activities include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, and loss of topsoil productivity. These impacts could increase runoff, decrease surface water infiltration, and lead to increased susceptibility of the soil to erosion and sedimentation.

It is possible that pumping for the Creamer water project would further reduce the water supply to the hydric soils found at playas, seeps, and springs due to drawdown associated with the pumping of groundwater from the Rustler Formation.

Vegetation management projects would result in a decrease of invasive species and an increase in vegetation with better soil holding capacity, which would be a beneficial impact to soil resources.

With implementation of standard and additional mitigation measures, the proposed project, when added to past, present, and reasonably foreseeable future actions is not expected to result in significant cumulative impacts to soil resources.

5.5 Air Quality

Cumulative impacts to air quality would include impacts from the proposed project emissions sources in combination with impacts from background emissions sources associated with past and present actions and RFFAs.

As described in Section 4.5, air dispersion modeling predicted that the maximum concentration of TSP from the proposed in-situ solution mine project would result in an annual impact of 15.7 $\mu g/m^3$ and a 24-hour impact of 54.7 $\mu g/m^3$. The addition of an annual and 24-hour TSP background concentration of 26.6 $\mu g/m^3$ would result in a total cumulative impact of 42.3 $\mu g/m^3$ on an annual basis and a total cumulative impact of 81.3 $\mu g/m^3$ on a 24-hour basis. These total cumulative impacts are well below the TSP annual and 24-hour NMAAQS of 60 $\mu g/m^3$ and 150 $\mu g/m^3$, respectively. All other modeled pollutant emission levels are well below the NAAQS and NMAAQS.

Cumulative air quality impacts in the vicinity of the proposed project would be minimal as oil and gas development is currently ongoing. Additional oil and gas development and plugging and abandoning old wells in the project vicinity would continue at generally the same rate that has been conducted in the past. Because past oil and gas activity is already included in the ambient background concentration, total cumulative impacts are expected to remain below the NAAQS and NMAAQS for the region.

5.6 Climate Change

Cumulative impacts to climate change would include impacts from the proposed project emissions sources in combination with impacts from background emissions sources and RFFAs and consider their incremental contribution to global and regional climate change. In 2008, total U.S. GHG emissions amounted to 6,956.8 teragrams (Tg) or million metric tons CO_2-equivalent, with net GHG emissions (which include GHG emissions sources while subtracting out GHG sinks) amounted to 6,016.4 Tg CO_2-equivalent (USEPA 2010b). Using the worst-case GHG emissions identified in Section 4.6, the estimated GHG emissions from the proposed project, including GHG emissions from construction, amount to 161,300 metric tons CO_2-equivalent. This equates to 0.0023 percent of the total GHG emissions in the United States in 2008.

Cumulative impacts to climate change in the vicinity of the proposed project would be negligible on a regional and global scale. Oil and gas development is currently ongoing, and additional oil and gas development in the project vicinity would continue at generally the same rate that has been conducted in the past. Past oil and gas activity is already included in the 2008 GHG emissions inventory, and the incremental contribution in addition to the proposed project would be small.

5.7 Vegetation

5.7.1 General Vegetation

The CESA for vegetative resources is the project area boundary for the action alternatives. Past and current projects are described in the affected environment and environmental consequences sections (3.7 and 4.7). For vegetative resources, the cumulative effects analysis focused on the past, present, and reasonably foreseeable impacts associated with mining, livestock grazing, recreation, oil and gas exploration and development, groundwater drawdown, noxious weeds, and vegetation management.

Past, present, and reasonably foreseeable future actions would cumulatively and incrementally reduce vegetation cover types until such time that reclamation is deemed successful and native plants are reestablished. Cumulative losses for vegetation resources potentially would include the reduction of native ecosystem functions such as soil stability, erosion control, livestock and wildlife forage, and wildlife habitat.

It is estimated that herbaceous-dominated plant communities would require a minimum of 3 to 5 years to establish adequate ground cover to minimize erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities would require 25 to 50 years for shrubs of similar stature to recolonize the area.

In addition to cumulative vegetation loss, other impacts on vegetation likely would occur as a result of cumulative forage use by livestock, and wildlife, affecting plant productivity and vegetation community structure and composition. Indirect impacts to vegetation resources associated with surface disturbance-related activities may include soil loss and compaction, habitat fragmentation, and introduction or spread of noxious weeds and invasive species. Fugitive dust from development activities can adversely affect native vegetation communities and alter vegetative composition (USEPA 2008c; USFWS 2008). Fragmentation of the landscape by the cumulative impact of multiple linear and localized surface disturbances can adversely impact native vegetative communities and native plant species.

Noxious weeds and invasive species exist throughout the CESA. Surface disturbance activities from implementation of the proposed project as well as other future projects could further spread noxious weed and invasive species into previously undisturbed areas, and may increase the acreage and population numbers of already established noxious weed and invasive species populations. Linear surface disturbances such as those associated with pipelines, roads, transmission lines and seismic surveys provide corridors for further spread of noxious and invasive species (Gelbard and Belnap 2003; Watkins et al. 2003) into the project area.

The combined impacts associated with surface-disturbing activities resulting from past, present, and future activities and the proposed project's groundwater drawdown would be likely to result in the increased spread of mesquite and noxious and invasive weed species into disturbed areas. Weed management and vegetation treatment projects would help to control this spread of invasive plants.

The BLM vegetation treatment projects to the north and east of the project area seek to increase native grasslands, and reduce the cover and amount of invasive native and non-native shrubs (creosote and mesquite). Successful reclamation of disturbed areas with native grasses and forbs could assist in restoring the native grasslands and other vegetation, and may further the goals of the vegetation treatment programs.

5.7.2 Sensitive Plant Species

5.7.2.1 Scheer's Beehive Cactus

Within the CESA, potential habitat for the Scheer's beehive cactus is found in desert grassland and Chihuahuan desert scrub, which are common land cover types within the area. Due to the limited knowledge of the species and its distribution, it is unknown whether the species actually occurs in the CESA. If the species does occur, direct adverse impacts would result from surface-disturbing activities associated with livestock grazing, off-road vehicle use, and construction. Indirect impacts would include habitat fragmentation, potential increased dust effects, and the temporary or permanent loss of suitable habitat.

5.7.2.2 Gypsum Wild Buckwheat

Within the CESA, potential habitat for the gypsum wild buckwheat is found in sparsely vegetated areas on gypsum soils. Known locations of the species are found northwest of the CESA near the border of Eddy and Chaves counties. Due to the extremely limited distribution of this species, it is unlikely the species is found within the CESA, so would not be affected by the proposed project or the RFFAs.

5.8 Wildlife and Fish

The CESA for wildlife and sensitive species includes the extent of the RFFAs shown in **Figure 5-1**. For wildlife resources, consideration was given to the cumulative effects of the past, present, and reasonably foreseeable mining activities, mining exploration programs, vegetation management, and potential habitat conversion associated with additional water depletion.

5.8.1 Terrestrial Wildlife

Cumulative impacts to wildlife resources would be primarily related to habitat loss, habitat fragmentation, and animal displacement and mortality. Nesting birds, small mammals, and reptile species would be the most susceptible to localized activities that remove their native habitat, especially in areas that may be at carrying capacity. Many of the local larger wildlife species like mule deer that occur in the CESA would be likely to continue to occupy their respective ranges and breed successfully, although population numbers may decrease due to cumulative habitat loss and disturbance from incremental development.

The RFFAs in combination with implementation of the proposed project would result in additional habitat disturbance. While these activities would result in an incremental increase in habitat-related wildlife impacts, reclamation and revegetation of disturbed areas would minimize the impacts to wildlife. The BLM vegetation treatment program would have a beneficial cumulative effect on habitat in the CESA over time.

Indirect impacts associated with human presence and noise would increase incrementally in the CESA due to the implementation of the RFFAs in combination with the proposed project.

Groundwater drawdown associated with existing and proposed pumping operations from the in-situ solution mine project and the Creamer water project would result in a long term reduction in the amount and extent of available water supply to seeps, springs, streams, and associated riparian habitats and wetlands used by wildlife. Potential loss or reduction of available groundwater or possible long-term effects to riparian communities could result in the loss of wildlife breeding, foraging, and cover. Animals that use perennial water sources would be displaced as the available water and riparian vegetation declines, concentrating the remaining animals within smaller habitat areas within the CESA.

Species likely to be adversely affected by the potential cumulative reductions of seeps, springs, streams, and riparian habitats include big game, upland game birds, raptors, songbirds, nongame mammals, amphibians, and reptiles. The extent of these indirect effects from water level change would depend on the species' use and relative species' sensitivity.

5.8.2 Fisheries

The combination of the pumping for the proposed in-situ solution mine project and the possible pumping for the Creamer water project may decrease the flows from Nash Draw that reach the Pecos River. This could decrease instream flows in the river, but the likelihood and amount of the change cannot be predicted with the currently available information.

5.8.3 Sensitive Species

Potential cumulative impacts to special status wildlife species would parallel those described above for terrestrial wildlife. Specific species impacts would be similar to those described in Section 4.8.

5.9 Rangelands and Livestock Grazing

The CESA for rangelands/livestock grazing is the entire five grazing allotments that encompass the project area and the additional twelve grazing allotments that encompass the existing and proposed Caprock pipelines. In addition to cumulative available forage and AUM loss resulting from the RFFAs and proposed solution mine in the area, the development of access roads and utility corridors would affect livestock grazing activities, livestock management, range facilities, and resources. Range facilities including water sources, fences, cattle guards, and corrals could be adversely impacted by construction and maintenance activities associated with the proposed project and the other future actions within the CESA. There may be a loss of access to water sources due to the placement and construction of new facilities, roads, and fences. Fences, cattle guards, and corrals could be damaged or destroyed by operation and maintenance activities, but maintenance and repairs would be required to mitigate damages on public lands.

Past, present, and RFFAs would cumulatively and incrementally reduce available acres of forage from active grazing preference during construction activities and where permanent structures or facilities are maintained. Successful reclamation and revegetation would result in an increase in native grasses that would be available for forage. Grazing may inhibit the reestablishment of woody species in grazing allotments.

5.10 Lands and Realty

The CESA for lands, realty, and transportation is the project area and the immediate surrounding area. Resource development has been prominent on the landscape in and around the project area for many years, and with the anticipation of 75 new oil and gas wells a year, this trend is likely to continue. New ROWs within the CESA may open up access to the public where none previously existed and may affect existing and future land uses; however, because the predominant use of the CESA is mining and fluid mineral development, cumulative impacts to land use and realty are expected to be minimal because the current land uses would continue.

The project area has a road network in place. Further expansion of this network to accommodate mineral resource development may have adverse and beneficial impacts. Adverse impacts would include an increase in traffic within the CESA and primary access roads, as well as greater maintenance needs on new and existing roads as heavy truck traffic increases. A potential benefit would include a larger maintained road network that may be utilized by recreational and other land users.

5.11 Recreation

The CESA for recreation is the project area with a 2-mile buffer outside the boundary. Within the CESA, there is already a considerable amount of surface disturbance caused by decades of potash mining and oil and gas development. Assuming 3 to 5 acres of initial surface disturbance for each well pad, approximately 260 acres per year would be disturbed.

Adverse cumulative impacts to recreational resources within the CESA include access closures (mostly short-term), increased noise and activity associated with resource development, and a reduction in dispersed camping opportunities. Due to previous potash and oil and gas development through the years, the existing road network has reduced the value of primitive recreational values in the area including naturalness, primitive and unconfined recreation, and solitude. Additional roads for mineral development would provide increased easy access to motorized recreational users. This increase in human activities from mineral development and motorized vehicles is likely to have a long-term impact on recreational users such as hunters and hikers who tend to avoid areas that have been heavily developed. While a substantial portion of the CESA would be affected by industrial activities from the proposed project in combination with other RFFAs, there would be minimal overall impact to recreational activities within the CESA.

5.12 Visual Resources

The CESA for visual resources is the project area, as well as the viewshed of the proposed project. This is the area within which public users (travelers on roads, recreational campers, hunters, OHV users, and hikers) would see potential changes in the landscape. The primary source of cumulative impacts to visual resources would be caused by mineral development. The management directive for visual resources for BLM-managed lands in the CESA allows for management activities that may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of activities through careful location, minimal disturbance, and repeating the basic landscape elements of color, form, line, and texture. Past, present, and reasonably foreseeable future resource development in the CESA would have both direct and indirect cumulative impacts to visual resources from emissions, ancillary facilities, and the general increase of human activities. In the future, the combination of all mineral development activities may dominate the view and become the major focus of viewer attention.

5.13 Cultural Resources

The CESA for cultural resources encompasses the project area. As directed by law, cultural resources inventories are conducted for any actions involving federal lands or requiring a federal permit, license, or approval. Avoidance through project redesign is the preferred method of mitigation; however, when avoidance is not feasible, data recovery or other forms of mitigation are implemented prior to ground-disturbing activities. All NRHP-eligible sites located in the project APE would be mitigated in accordance with the Protocol Agreement. In addition, any previously unknown NRHP-eligible sites that may be discovered during construction activities would be mitigated in accordance with applicant-committed protection measures. Therefore, the proposed project is not expected to cumulatively contribute to direct effects to NRHP-eligible sites. However, if data recovery is necessary to mitigate unavoidable effects to NRHP-eligible sites, the process would recover a significant amount of data but ultimately the site would be destroyed by the undertaking. Over time, this represents a cumulative loss.

Indirect effects, such as illegal collecting of artifacts, have occurred and most likely would continue to occur in the CESA due to increased access, development, and increased human presence.

No sites of tribal importance, including TCPs, were identified by any of the tribal groups contacted by the BLM as part of the Section 106 consultation efforts. Therefore, no cumulative effects to sites of tribal importance, including TCPs are anticipated as a result of the Preferred Alternative.

5.14 Health and Safety, Hazardous Materials

The CESA for health, safety, and hazardous materials handling is the SPA. The transportation and use of hazardous materials and the generation and disposal of solid waste due to the proposed project and the RFFAs would represent a small increase from current conditions. Potash processing at the new HB mill, as well as fluid mineral development, would result in a small incremental increase in the use of hazardous materials and the generation of wastes that must be disposed of safely in the CESA. Assuming that all of the potash mines and oil and gas development locations follow state and federal laws for hazardous materials management, waste handling, spill prevention and cleanup, and health and safety, the cumulative impacts would be minimal.

5.15 Socioeconomics and Environmental Justice

This section addresses the socioeconomic impact of the project alternatives when added to the past, present and RFFAs in the CESA, which is defined as Eddy and Lea counties. Past mining and oil and gas development are two key elements of the existing regional economy and social conditions. Other historically and economically important segments of the region’s economic base are agriculture, recreation, tourism, and more recently, lifestyle migration. The effects of past and current development in the region are evident in the existing settlement patterns, physical development and infrastructure, fiscal structures, and social settings and networks in the region. Such development and the related activities, events, and people associated with it provide the area with its rich heritage and cultural history. Absent the area’s mineral and energy resource endowments, the region would likely be much less developed and populated than it is today.

The collective past development activity has contributed to growth and development and underlies important economic and social conditions and trends in the area. These trends include labor markets characterized by unemployment that is commonly below statewide levels, higher transient elements of the work force, competition and occasional shortages of qualified labor and cyclical population change. Such growth has provided much of the impetus for new residential and commercial development and expansion of local government infrastructure and services. Social effects of development also have occurred and natural resource development has resulted in some conflict between the mineral and energy resource industries, and with recreation, tourism, and grazing on public lands. Development-related impacts to recreation arise from fragmentation of contiguous areas available for outdoor recreation, changes in access, and development related traffic, dust and other factors that affect the quality of recreational experiences.

The Preferred Alternative would occur in the socioeconomic context and setting described above. The past and present development activities helped create a setting based in part on natural resource development and more specifically, with potash extraction, contributing to conditions wherein local labor, housing resources, community infrastructure, and local government are capable of accommodating construction projects. Consequently cumulative effects of past and present socioeconomic conditions, when combined with the Preferred Alternative is likely to be mainly beneficial

Cumulative effects on socioeconomic conditions in the CESA from the proposed project with present and future actions would potentially arise if the employment, economic activity, population, housing, public service demand, and fiscal aspects of RFFA projects occurred concurrently with those of the proposed in-situ solution mine project. Cumulative socioeconomic activities also could occur if activities or land use associated with RFFAs occupied or proposed to use the same surface or subsurface areas as the Preferred Alternative. Cumulative socioeconomic impacts have the potential to be both beneficial and adverse.

The construction schedule for the planned improvements to Intrepid's East Mine langbeinite process plant would overlap the construction schedule for the Preferred Alternative in 2012. Intrepid's projected construction work force for the first quarter of 2012is relatively low (74 workers) and should not result in substantial cumulative effects on housing or public service demand on Eddy County or nearby communities. Although the Preferred Alternative-related work force is projected to increase to 237 workers during the final quarter of 2012, the East Mine improvements are anticipated to be completed during that period, minimizing the potential for cumulative work force-related impacts on local communities. The sequencing of the East Mine improvements and the Preferred Alternative may provide an opportunity to transition portions of the construction work force from one project to the next, sustaining the construction period and enhancing the beneficial aspects of construction such as project and employee spending and increases in local gross receipts tax revenues from company and construction worker purchases.

Given the current exploration and project feasibility status of the Intercontinental Potash polyhalite project (Project 2 in **Table 5-1**), it is unlikely that the project would initiate construction in time to coincide with the construction schedule for the Preferred Alternative. The project's location also would preclude land use and construction activity impacts.

The BLM's vegetation and construction management activities could coincide in time with Preferred Alternative-related construction activities but would be temporary and different in nature so would not be likely to result in substantial land use or construction activity impacts.

If construction of a new parking lot on the Hackberry Lake SRMA were approved, there would be the potential for the timing of some traffic and construction activities to coincide with the proposed in-situ solution mine project. This would not be anticipated to result in substantial cumulative effects, given the relatively small level of construction required and the short schedule anticipated for parking lot construction. Ongoing trail maintenance activities within the recreation area would not be anticipated to result in cumulative socioeconomic impacts due to the small number of jobs and multiple locations involved.

The proposed Creamer water project may similarly coincide with the construction schedule for the Preferred Alternative, but would result in relatively minimal additional cumulative construction activity and traffic.

Ongoing oil and gas activity was anticipated as part of the socioeconomic baseline. A relatively constant level of ongoing oil and gas development activity is assumed in the assessment of existing socioeconomic conditions within the CESA, which would not represent an incremental cumulative impact.

Based on the foregoing, major cumulative socioeconomic effects are not anticipated to be associated with any of the RFFAs.

5.16 Summary of Cumulative Impacts

In general, the implementation of the proposed in-situ solution mine project in conjunction with the RFFAs listed in **Table 5-1** would result in small incremental changes to the landscape and impacts on the human environment in the project area and the region. Groundwater is the resource likely to experience the greatest potential cumulative effects.

Pumping from the Rustler Formation to supply water to the Creamer project and for oil and gas development would increase the predicted substantial drawdown of existing groundwater levels in the project area if the pumping scenarios analyzed for the Proposed Action occur. The in-situ solution mine project-related drawdown is expected to alter vegetation communities and associated wildlife habitat in the project area. Because the project-related groundwater drawdown would already be major, it is unlikely that the incremental increase of groundwater drawdown due to implementation of the Creamer water project or fluid mineral development would result in additional significant changes to vegetation and wildlife habitat.

Groundwater from the project area that supplies instream flows to the Pecos River is likely to be reduced more by the combined effects of the proposed project and the RFFAs than by the proposed project alone. The cumulative effects of the proposed project and the RFFAs in the region may incrementally change each of the other resources analyzed, but the amount of the impacts are anticipated to be relatively small.

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6.0 Consultation and Coordination

This chapter reviews agency and public consultation and coordination that occurred prior to and during preparation of this EIS. It also includes a list of the BLM resource staff who provided information and reviewed the EIS, the staff from AECOM, the contractor selected to prepare the EIS under the direction of the BLM, and the list of agencies and individuals who received the draft EIS.

6.1 Public Involvement

The Notice of Intent (NOI) to prepare an EIS for the HB In-Situ Solution Mine Project was published in the *Federal Register* on January 12, 2010. Consultation and coordination with various federal, state, and local agencies, organizations, and individuals has been accomplished through formal and informal means of communication, including meetings, interviews, e-mail exchanges, telephone calls, and other verbal exchanges. The description of the public scoping process and the issues identified during public scoping is presented in Chapter 1.0, Section 1.5 of this EIS.

A newsletter bulletin was mailed to 146 interested parties including federal, state, and local agencies and governments to explain the proposed project and announce the start of public scoping. BLM received a total of 17 comment submittals (e.g., letter, comment form, verbal comments) containing 133 individual comments during the 30-day public scoping period. In addition to the two public scoping meetings held on January 26, 2010, in Carlsbad, New Mexico, some interviews of selected state and local government representatives were conducted to collect information particular to issues related to socioeconomics.

The Notice of Availability (NOA) for the Draft EIS was published in the *Federal Register* on April 15, 2011. This began the 60-day period for public review and comment of the Draft EIS. Prior to publication of the NOA, The BLM mailed the second project Bulletin to 111 people who indicated that they wanted to be on the mailing list. The BLM mailed hard copies of the Draft EIS to nine people or agencies and 62 electronic copies on CD, based on requests and agency policy. E-mail notification of the NOA and the availability of the Draft EIS for downloading from the project website were sent to 55 people who provided addresses.

Two public meetings to receive public comments on the Draft EIS were held from 3:00 p.m. to 7:00 p.m., one each in Carlsbad (May 10, 2011) and Hobbs (May 11, 2011), New Mexico. The meetings were publicized through the project website, public service announcements to local radio and television stations, and through display advertisements in Artesia Daily Press, Hobbs News-Sun, and Carlsbad Current-Argus. The meetings began with a formal presentation to the public to ensure that meeting attendees were informed about the project and the findings in the Draft EIS. The presentation was followed by an informal open house to allow meeting attendees to ask questions and submit comments. BLM representatives staffed information stations with display boards showing the alternatives analyzed in detail, some of the key findings from the impact analysis, and information on the NEPA process. Sixty members of the public attended the Carlsbad meeting and 18 people attended the Hobbs meeting.

During the public comment period, The BLM met with representatives from local governments and state and federal agencies to answer questions and explain the findings of the Draft EIS. In response to a request from one agency, The BLM extended the public comment period by two weeks, closing on June 23, 2011 instead of June 13 as originally scheduled.

The BLM received 27 distinct comment letters and 139 form letters from which 217 unique comments were categorized. The comments and responses are provided in **Appendix D** where they are grouped by category.

6.2 Agency Coordination

Consultation with the USFWS to date has been conducted informally. Numerous conversations and e-mail exchanges with a variety of USFWS biologists have been completed in pursuit of guidance and recommendations regarding anticipated impacts from the proposed project and recommendations for potential mitigation measures that would be appropriate. To date, no formal consultation has been initiated under Section 7 of the ESA or the Fish and Wildlife Coordination Act. Currently, the sand dune lizard is under consideration for formal listing as a threatened species, but the final decision is not expected before summer of 2012. A biological assessment evaluating the effect of the Preferred Alternative on sand dune lizard and its habitat was submitted to the USFWS by the BLM on October 24, 2011.

On December 21, 2010, the BLM mailed letters of invitation for cooperating agency status to 42 federal, state, and local government agencies, and interested tribes and pueblos. Formal cooperating agency agreements have been signed by eight organizations: the cities of Carlsbad, Eunice, and Hobbs; Chaves and Lea counties; the Mining and Minerals Division of the New Mexico Energy, Minerals and Natural Resources Department; the New Mexico Environment Department; and the U.S. Department of Energy. The Hopi Tribe and three federal agencies declined the invitation to become cooperating agencies.

6.3 Tribal Consultation

On February 1, 2010, the BLM sent letters to the Mescalero Apache Tribe, Apache Tribe of Oklahoma, Comanche Indian Tribe, Pueblo of Isleta, Kiowa Tribe of Oklahoma, Ysleta del Sur Pueblo, and Hopi Tribal Council as part of the consultation efforts for the proposed project. To date, only the Hopi Tribe, Pueblo of Isleta, and Ysleta del Sur Pueblo have responded. The Hopi Tribe, Pueblo of Isleta, and Ysleta del Sur Pueblo have no concerns with the proposed project but requested to be notified in the event unanticipated discoveries, including human remains, are unearthed during project construction. No TCPs or places of cultural and religious importance have been identified in the project area by the tribal groups.

The BLM intends to continue consultation throughout the environmental review and construction phase of the proposed project, if approved. Renewed contacts with some or all of the tribes may result if there are unanticipated discoveries.

6.4 List of Preparers and Reviewers

The people listed in the following table, **Table 6-1**, provided oversight, information, and review of the EIS. All staff are located at the BLM Field Office in Carlsbad, New Mexico.

The people listed in **Table 6-2** prepared the EIS under the guidance of the BLM staff listed in **Table 6-1**.

Table 6-1 BLM Interdisciplinary Team

Resource/Responsibility	BLM Team Member	Education and Experience
Project Manager	David Alderman	BA Molecular Biology and Biochemistry; MS Environmental Science and Management 1 year of experience in NEPA and project management

Table 6-1 BLM Interdisciplinary Team

Resource/Responsibility	BLM Team Member	Education and Experience
Mining	Craig Cranston	BS Geology; MA Business and Economics 15 years experience in the Potash Industry as a mine engineer; 19 years experience with BLM as a mining engineer.
Geology	Jim Rutley	BS Geology 15 years experience in Potash Surface Production Operations; 2 years experience in Oil and Gas in the Permian Basin; 3 years experience with BLM as a geologist (specializing in Potash)
Geology	Joe Galluzzi	MS Geological Sciences; BS Geological Sciences 1.5 years experience with BLM as a geologist, fluid and solid minerals; 7 years experience as geologist in civil engineering (surface mining, surface water and groundwater modeling, environmental assessments)
Caves/Karst	Jim Goodbar	BS Park and Recreation Management Texas; Graduate Studies Karst Geology 51 years caving experience globally, 31 years with BLM cave/karst program; Last 11 years as senior cave/karst specialist with the BLM Washington Office
	Aaron Stockton	BS Agriculture, Ag Econ and Business, Option in Natural Resources Management 16 years caving experience, 6 years experience in cave management with the federal government (USDA-FS and BLM)

Table 6-1 BLM Interdisciplinary Team

Resource/Responsibility	BLM Team Member	Education and Experience
Hydrology	Carolyn Moores	BS Geology; MS Hydrology 5 years experience as oil exploration geologist; 9 years experience in surface water and groundwater quality assessment on federal lands 1 year experience as BLM hydrologist
Cultural Resources	James Smith	A.A. Heritage Interpretation; BS Anthropology & Applied Archaeology 1.5 years experience in NEPA with BLM
Biological Resources	John Chopp	BS Wildlife and Fisheries Management 2 years experience as USDA-FS biological technician; 3 years experience as BLM wildlife biologist
Soils/Reclamation	Steve Daly	BS Wildlife Science 30 years experience with BLM range staff, 20 years as soil, water, air program lead
Recreation, Visual Resources	Deanna Younger	BS Parks and Recreation Management 1.5 years experience with BLM as outdoor recreation planner. 9 years experience with USDA-FS in cave and recreation management
Geographic Information Systems	Dario Lunardi	BS Parks and Resource Management/Environmental Education; MS Park Resource Management 5 Years experience with BLM in GIS
Associate Field Manager for Resources	Jeanette Martinez	AS Word Information Processing 20 years experience BLM administration; 4 years experience realty

Table 6-2 AECOM EIS Team

Resource/Responsibility	AECOM Team Member	Education and Experience
Project Management	Ellen Dietrich	BA Anthropology; Graduate Study Soil Science 32 years experience
Project Coordinator	Lindsey Hart	BS Anthropology-Zoology and English 5 years experience
Geology and Minerals, Paleontology	William Berg	MS Geology 31 years experience
Groundwater Lead	Robert Berry	PhD Geology/Geochemistry 26 years experience
Rustler Groundwater Models	James Rumbaugh, Environmental Simulations, Inc.	BA and MS Geology 30 years experience
Caprock Groundwater Model	Enrique Triana	PhD Civil and Environmental Engineering; MS Civil Engineering; BS Civil Engineering 11 years experience
	Rachel Pittinger	BS Civil Engineering 11 years experience
Surface Water	David Fetter	BS Watershed Science 9 years experience
Soils	Terra Mascareñas	BS Soil and Crop Science 13 years experience
Air Quality, Climate Change	Vince Scheetz	MS Systems Management; BS Mathematics; Graduate Study Atmospheric Science 40 years experience
	Charles Cornell	BS Environmental Sciences 16 years experience
Vegetation, Rangelands/Livestock Grazing	Erin Bergquist	MS Ecology; BA Environmental Studies & Economics 8 years experience
Wildlife and Fish, Biological Assessment	Matt Brekke	BS Wildlife Biology 5 years experience
Lands and Realty, Recreation, Visual Resources, Health and Safety, Hazardous Materials	Steve Graber	BS Natural Resources Management; BA Economics 6 years experience
Cultural Resources	Kim Munson	MA and BA Anthropology 31 years experience

Table 6-2 AECOM EIS Team

Resource/Responsibility	AECOM Team Member	Education and Experience
Socioeconomics and Environmental Justice	Ron Dutton, Sammons/Dutton LLC	MS and BS Economics 32 years experience
	George Blankenship, Blankenship Consulting	Master of Urban and Regional Planning; BA Social Work; BA Anthropology 31 years experience
Geographic Information Systems	Scott MacKinnon	BS Physical Geography 7 years experience
Word Processing / Document Formatting	Sue Coughenour	Two Years General Studies 25 years experience

6.5 Recipients of the Draft EIS

Numerous governmental bodies and agencies, businesses, organizations, and individuals received copies of the Draft EIS or notification of its availability. This list was developed by including those people who requested to remain on the mailing list at the beginning of the project, attendees at public scoping meetings, key representatives of local, state, and federal agencies and organizations, and representatives of federal agencies who are required to receive copies of EISs prepared by the BLM. The Draft EIS also was posted on the project website (http://www.nm.blm.gov/cfo/HBIS/) and made available in local libraries for public review. Notification of publication of the Final EIS will be distributed to the mailing list that includes people who commented on the Draft EIS. The Final EIS will also be posted to the project website.

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Glossary

acre-foot. The volume of water sufficient to cover one acre of land to a depth of 1 foot. Equals 43,560 cubic feet or approximately 325,851 U.S. gallons.

Albedo. The amount of solar energy (shortwave radiation) reflected from the Earth back into space. It is a measure of the reflectivity of the earth's surface.

Anhydrite. Relatively common sedimentary mineral that forms massive rock layers and develops from the dewatering of gypsum.

Anticline. A geologic structure in which rocks are folded so the rock layers are convex, forming a dome, with the younger rocks on the outside.

Applicant–committed Environmental Protection Measures. Actions agreed to in advance of project initiation by the proponent; designed to protect resources.

Aquifer. A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Aquitard. A bed of low permeability adjacent to an aquifer that may store groundwater, although it does not yield water readily.

Aridisols. Soils that occur under arid climates, where evaporation greatly exceeds precipitation. They are characterized by an accumulation of carbonates and other salts.

Big Game. Native ungulate wildlife species that are hunted, such as deer and pronghorn antelope.

Biological Soil Crust. Community of non-vascular primary producers that occur as a "crust" on the surface of soils; made up of a mixture of algae, lichens, mosses, and cyanobacteria (bluegreen algae).

Breccia. A deposit consisting of fragmented rock materials caused by the collapse of underground voids due to dissolution of evaporite layers.

Clastic rocks. Sedimentary rocks composed of particles weathered from any type of pre-existing rocks and minerals.

Convergence (mining). Closure of the mined area through subsidence

Cumulative Effect. The impact that results from identified actions when they are added to other past, present, and reasonably foreseeable future actions regardless of who undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Diagenetic (geology). The process of chemical and physical change in deposited sediment during its conversion to rock.

Drawdown Contour. A line derived from water modeling that depicts a certain lowering of the water level compared to its previous level.

Drawdown. The lowering of the water level in a well, spring, water body, or water table as a result of water withdrawal from an aquifer.

Elastoplastic rock. Massive, homogeneous, and relatively elastic rock with load-deformation characteristics that allow the rock to deviate significantly from a straight line without fracturing.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no continuous supply from melting snow or other source, and its channel is above the water table at all times.

Erosion. Detachment and movement of soil or rock fragments by water, wind, ice, or gravity. Wearing away of the land surface by running water, wind, ice, or other geologic agents, including such processes as gravitational creep.

Escarpment. A long, precipitous, cliff-like ridge of land or rock, commonly formed by faulting or fracturing of the underlying bedrock.

Evaporite (geology). Any of a variety of minerals found in the sedimentary deposit of soluble salts that result from the evaporation of water.

Facies (geology). A rock or stratified body with specific characteristics such as appearance or composition.

Forage. The plant material actually consumed by or available to grazing animals.

Fugitive Dust. A non-point source of air pollution, such as from unpaved roads, agricultural croplands, and construction sites.

Granitic (geology). A common, coarse-grained, light-colored, hard igneous rock consisting chiefly of quartz, orthoclase or microcline, and mica.

Groundwater. Subsurface water that is in the zone of saturation. The top surface of the groundwater is the "water table." Source of water for wells, seepage, springs.

Gypsite (geology). A variety of gypsum consisting of dirt and sand, found as a deposit in arid regions overlying gypsum.

Habitat Fragmentation. The division of large contiguous blocks of wildlife habitat into isolated smaller parcels separated by distances great enough to discourage wildlife movement between parcels.

Habitat. An environment that meets a specific set of physical, biological, temporal, or spatial characteristics that satisfy the requirements of a plant or animal species or group of species for part or all of their life cycle.

Hypersaline. Extremely salty, having much more salt than normal seawater or brine water.

Karst. Terrain with distinctive, often rolling, landforms created from the dissolution of soluble rocks, principally limestone and dolomite. It is characterized by springs, caves, and sinkholes that are often directly connected to aquifers.

Langbeinite. A potassium magnesium sulfate mineral with formula $K2Mg2(SO4)3$.

Metamorphic (geology). Rock that has been changed or transformed from its original form by excessive heat or pressure.

pH. A measure of the acidity or alkalinity of a solution. The pH scale ranges from 0 to 14, with 7 used for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity.

Physiography. The physical geography of an area, characterized by similar landforms and geology.

Potash. Common name for various mined and manufactured salts that contain potassium in water-soluble form.

Potentiometric surface. The level to which groundwater would rise if not confined; equivalent to the top of a water table in an unconfined aquifer.

Sedimentary rocks. Rocks formed by accumulation and cementation of minerals transported by wind or water, or chemically precipitated.

Sylvite. Potassium chloride in natural mineral form. It forms crystals in the isometric system very similar to normal rock salt, halite.

Talus. The loose rock created by physical weathering, typically found on a steep mountainside or at the base of a cliff or slope.

Topography. The form and structure of the surface of land.

Troglobidic species or troglobites. Small cave-dwelling animals adapted to their dark surroundings.

Volcanic (geology). Relating to or produced by volcanoes.

Vug. A small cavity in a rock or vein, often with a mineral lining of different composition from that of the surrounding rock.

Watershed. The area of land where all of the water that drains from it flows into the same place.

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